# THE PROM SETTER

# MANUAL

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SZERLIP ENTERPRISES
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ERRATA INFORMATION

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Factory service 1.3.3, page 4 second paragraph line 1, first word
Under....

COMPONENTS, Page 7
R43 should be 2.2K
C9 — 100 uf 35V
C8, C10 through C4 — 0.1 uf 50V

STEP 4B, page 12, second paragraph
donot use the flat washer

STEP 13, — page 17
Add in Step 13D and E, a "1" is a voltage over 2.5 Volts

STEP 15A and B, — page 20
Capacitors C7 and C9,....and the C9 negative....

STEP 17 b) — bottom page 22
....capacitor C9 negative lead...lead of C9

Wave form C9 negative — top page 23

MAIN MODULE BOARD, — bottom page 41
....Capicitor C9 is charged....
....end of C9 to about -48 volts.

ERROR INDICATIONS 3.3.5, second and third paragraph — page 47
....the number "3" will result.
....the number "0" is produced

PULSE GENERATOR OPERATION 4.5, — bottom page 53
....negative lead of C9 for the....

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2. Write 2704/2708 (ØØ46) — figure 10

5. Print (Ø195) — nr. bottom p. 56, Fig. 26

The full program uses 512 words. — mid. page 57

....programming of the 256 words. — bottom page 57

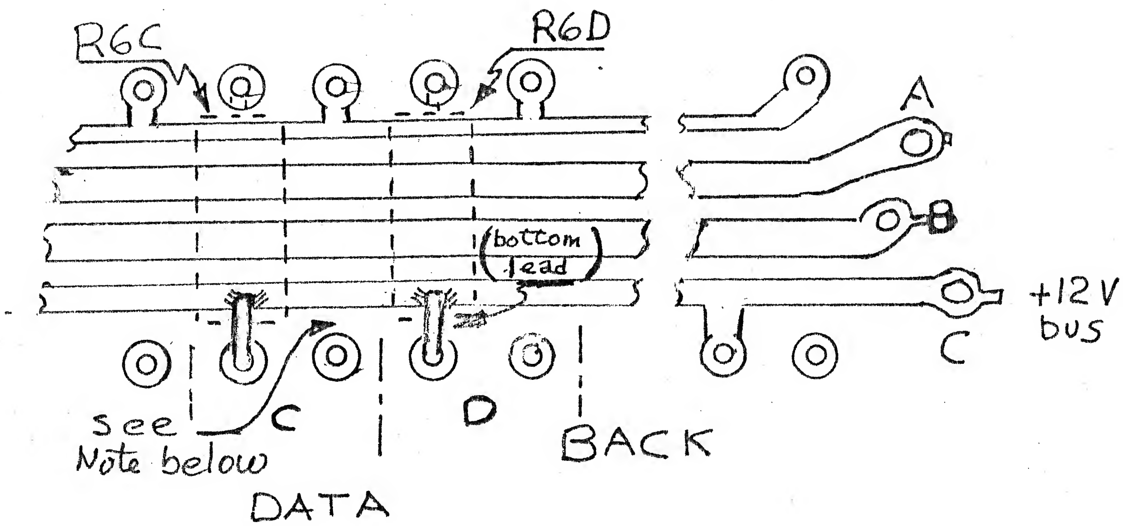
Relocation of the PROM SETTER Program 5.2.4, — page 60

| | | | |
|---|---|---|---|
| OIFD | Ø4 | Ø5 | Ø4 |
| 2708 Write | ØØ46 | | |

....Test program location at ØØ7Ø.

STEP 8b, page 14, R6 installation

Register R6 C and D requires slight change in the assembly procedure. During the assembly of R6 C and D (10K ohm) bend the bottom lead up till it crosses the +12 volt bus, (line C). Cut the resistor lead in the center of this line being careful not to extend into the next printed wire lines, as shown on the next page. Solder the resistor to the +12 volt bus.




Note this pad (at C) must NOT have any connection to the +12 Volt bus.

## ADDITIONAL INFORMATION

The 1702A require over 1 microsecond read time. A prom board would require a wait state of two cycles giving 1.5 us.

If the PROM SETTER program is stored on the 1702A, then a change in the Delay subrutine is required, as shown below. (see page 71 statement starting at ØØDC)

| Statement | Clock rate 500 Ns | 1.0 us | 1.5 us |
|---|---|---|---|
| ØØDD | Ø3 | Ø3 | Ø2 |
| ØØDE | FØ | FØ | FØ |
| ØØE8 | 1Ø | 1Ø | ØA |
| ØØEE | 61 | 5Ø | 4Ø -01 |
| ØØF4 | ØE | Ø9 | Ø9 |
| ØØFA | Ø3 | Ø2 | Ø2 |

## CAUTION

Care must be taken when handling the main module board due to the sharp prongs of the IC sockets which can cause skin cuts to the hand.

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# SECTION I

# INTRODUCTION AND GENERAL INFORMATION

## THE PROM SETTER MODULE

## AND

## EPROM SOCKET UNIT

## 1.1 INTRODUCTION

This manual contains the information required to assemble, test and operate The Prom Setter. It is suggested that you first scan the entire manual before starting assembly or using The Prom Setter.

Secondly, for kit purchases, check the parts list against the supplied material. Inform us immediately if you discover any discrepancy.

It is best that you follow the assembly procedure as outlined in Section II. Use the best type of tools to insure professional results.

If you experience difficulty or problems during assembly, feel free to contact us. We will do our best to assist you. If the completed unit does not function properly, recheck your assembly, check for backward or wrongly placed components. See Section 1.3.3 for details of factory servicing.

## 1.2 THE PROM SETTER GENERAL DESCRIPTION

The Prom Setter is designed to be compatible with the S-100 bus, such as is used in the Altair/IMSAI computer, and utilizes the existing power supply of the computer to perform its tasks. (No external power supplies are required.)

The Prom Setter consists of a main module board, TPS 100, and an external EPROM socket board, TPS 200, with interconnecting cables.

The Prom Setter will write and read a number of Programmable Read Only Memory (PROM). The TPS-100A with socket set TPS-200A is used for writing and reading the 1702A, the 2704 and 2708 Erasable Programmable Read Only Memory (EPROM). When not used as a Prom Setter, the main module board can be used as an eight-bit parallel I/O port (see Section 3.2.4).

The Prom Setter address is selectable to any of 63 address segments (FF is used by the computer) of the 256 I/O addresses available with the microprocessor. It uses four (4) consecutive addresses. The first two bits of the address ($A_0$ and $A_1$) are used to select which registers of The Prom Setter are to be activated. The rest of the address, $A_2$ through $A_7$, is selectable by you. (See Section 2.2.1, Step 11.)

The Prom Setter main module (TPS-100) contains all the electronics required to read and write a PROM, such as the 1702A. This module plugs directly into the S-100 bus of the computer. On the top of this module

is a 50-pin edge connector, which is used to interconnect this unit to The Prom Setter socket (TPS-200).

An interconnecting cable is used to bring the output of the main module to the rear of your computer. This cable has 50-pin connector which mates to the main module on one end and several DB25 pin connectors on the other end. The DB25 connectors are attached to the rear of your computer.

These 25-pin connectors at the rear of your computer are used to interconnect the external Prom Setter socket unit to the main module. The connectors arrange the appropriate socket connections for the given PROM type that is to be read or set.

A Write-Disable switch is provided on The Prom Setter Socket unit. This switch, when in the "Write Disable" position, insures that no possibility of write conditions can exist. It is advised that this switch be in the "Write Disable" position when inserting and removing the PROM and also during the read operation.

All control and operation of The Prom Setter is accomplished by the computer itself. The computer sets a series of latches which define the address and data lines. A latch is also used to control the programming signals.

Tristate units are used to buffer the PROM read data to the S-100 data bus lines. Low power input units are used for all input lines.

## 1.3 GENERAL INFORMATION

### 1.3.1 Receiving Inspection

Carefully inspect all materials shipped for signs of damage. Also check the packing list to insure that all materials were received.

If any discrepancies are found or damage noted, please write us at once, describing the condition, so that we can take appropriate action. Save the shipping material until your inspection proves that the material received is satisfactory.

### 1.3.2 Replacement Parts

Replacement parts will be supplied upon request (see Section 1.3.4). When requesting replacement parts, be sure to properly describe the components requested.

### 1.3.3 Factory Service

Factory service is offered for in-warranty and out-of-warranty units. Before returning The Prom Setter for service, it is required that you obtain authorization to do so. Upon receiving authorization for factory service, package the unit to prevent damage and return postpaid to:

SZERLIP ENTERPRISES
1414 West 259th Street
Harbor City, California 90710

Uner separate correspondence, send information of the shipment, giving carrier and waybill number. To protect yourself, it is suggested that you insure the package.

### 1.3.4 Warranty

The parts supplied in The Prom Setter are warranted against defects in material and workmanship for a period of ninety (90) days after the date of shipment or purchase, whichever is the later date.

A complete "Statement of Warranty" is given in Appendix I.

### 1.3.5 Tools

Before undertaking kit assembly, you should have professional tools. A quality soldering iron will insure a professional product. Soldering guns should not be used. For additional information on this subject, see Appendix II.

As a minimum, a voltmeter will be required and, preferably, an oscilloscope should be available to check out The Prom Setter.

An S-100 extender board would prove helpful during the checkout of the unit.

# SECTION II

# ASSEMBLY

## 2.1 GENERAL

Before starting to assemble The Prom Setter, it is necessary to insure that the ±16 volt lines have sufficient voltage to allow acceptable operation of the unit. Some early computers had very small power transformers which results in low supply voltages.

Using an extender board, insert the TPS-100 board (without any components) into the extender board, and the extender board into the S-100 bus. Turn on the computer and, with a dc voltmeter, measure the +16 and then the -16 volt lines. These are located at the upper left-hand side of the board. Record the results for future reference.

| | | |
|---|---|---|
| +16 volts | | +14 volts minimum |
| -16 volts | | -14 volts minimum |

If the voltage is lower than the minimum given at the right side of the boxes (i.e., ±14 volts), you should consider rebuilding the power supply. In some computers, series of diodes were used in the ±16 volt supply to reduce the supply voltage when the loads are light. In these cases, low supply voltage can be increased by removing some of the extra series diodes. Under no circumstance do you ever remove all the diodes. At least one set of diodes is required for proper supply operation.

CAUTION

(A) Some of the devices used are MOS integrated circuits which can be DAMAGED by static electricity discharge. Avoid unnecessary handling of the MOS IC's. Synthetic clothing tends to generate static electricity. Cotton clothing is preferable.

The above applies to the EPROM's.

(B) Damage may occur if accidental shorting of adjacent components leads takes place. If it becomes necessary to make electrical measurements of components on the board, use extreme care.

(C) Make sure that the proper transistor is inserted in its appropriate position and that the leads are not crossed. Use the plastic pads supplied under each of the TO-18 transistor types. The transistor should be pushed down on these pads and then align the transistors so that they do not touch the unit next to them. (Note that the collectors are electrically connected to the metal TO-18 can.)

## MAIN MODULE

| Circuit Symbol | Component | Circuit Symbol | Component |
|---|---|---|---|
| U1 | 7404 | R17 | 680 ohm 1/4w |
| U2 | 74155 | R18 | 10k ohm 1/4w |
| U3 | 4009 | R19, R20, R25 | 2.2k ohm 1/4w |
| U4 | 8131 | R26 | 680 ohm 1/4w |
| U5 | 4009 | R27 | 2.2k ohm 1/4w |
| U6 | 74L00 | R28 | 2.2k ohm 1/4w |
| U7 | 74367/8097/8T97 | R29 | 2.2k ohm 1/4w |
| U8 | 74367/8097/8T97 | R30 | 680 ohm 1/4w |
| U9 | 74L75 | R31 | 2.2k ohm 1/4w |
| U10 | 7400 | R32 | 1k ohm 1/4w |
| U11 | 7404 | R33A/B | 2.7 ohm 1/4w |
| U12 | 7410 | R34A/B | 2.7 ohm 1/4w |
| U13 | 74L75 | R35A/B | 2.7 ohm 1/4w |
| U14 | 74L75 | R36 | 10k ohm 1/4w |
| U15 | 74L75 | R37 | 2.2k ohm 1/4w |
| U16 | 74L75 | R38 | 2.2k ohm 1/4w |
| U17 | 74L75 | R39 | 330 ohm 1/4w |
| U18 | 74367/8097/8T97 | R40 | 47 ohm 1/4w |
| U19 | 74367/8097/8T97 | R41 | 2.2k ohm 1/4w |
| R1A through R1H | 680 ohm 1/4w | R42 | 1k ohm 1/4w |
| R2A through R2H | 2.2k ohm 1/4w | R43 | 2.2K ~~1k~~ ohm 1/4w |
| R3A through R3H | 10k ohm 1/4w | R44 | 680 ohm 1/4w |
| R4A through R4H | 680 ohm 1/4w | R45 | 2.2k ohm 1/4w |
| R5A through R5H | 2.2k ohm 1/4w | R46 | 10k ohm 1/4w |
| R6A through R6H | 10k ohm 1/4w | R47 | 1k ohm 1/4w |
| R8A through R8F | 2.2k ohm 1/4w | C1 | 4.7 µf 25v |
| R9 | 120 ohm 1/4w | C2 | 22 µf 25v |
| R10 | 2.2k ohm 1/4w | C3 | 4.7 µf 25v |
| R11 | 2.2k ohm 1/4w | C4 | 22 µf 25v |
| R12 | 680 ohm 1/4w | C5 | 4.7 µf 25v |
| R13 | 2.2k ohm 1/4w | C6 | 22 µf 25v |
| R14 | 680 ohm 1/4w | C7 | 47 µf 25v |
| R15 | 2.2k ohm 1/4w | C8, C9 | 100 µf 35v |
| R16 | 68 ohm 1/4w | C8, ~~C9~~ C10 through C14 | 0.1 µf 50v |

| Circuit Symbol | Component | | |
|---|---|---|---|
| CR1A through CR1H | 1N5254 | 27v | Zener |
| CR2A through CR2H | 1N4001 | | Diode |
| CR3 | 1N5342 | 6.8v | Zener |
| CR4A through CR4H | 1N5254 | 27v | Zener |
| CR5A through CR5H | 1N4001 | | Diode |
| CR7 | 1N4001 | | Diode |
| CR9 | 1N5254 | 27v | Zener |
| CR10 | 1N5254 | 27v | Zener |
| CR11 | 1N5240 | 10v | Zener |
| CR12, CR13, CR14 | 1N4001 | | Diode |
| CR15 | 1N5223 | 2.7v | Zener |
| CR18 through CR24 | 1N4001 | | Diode |
| CR25 | 1N5261 | 47v | Zener |
| CR26 | 1N5254 | 27v | Zener |
| CR27 | 1N4001 | | Diode |
| Q1A through Q1H | 2N2907A | PNP | Transistor |
| Q2A through Q2H | 2N2222A | NPN | Transistor |
| Q3A through Q3H | 2N2907A | PNP | Transistor |
| Q4A through Q4H | 2N2222A | NPN | Transistor |
| Q5 | 2N2222A | NPN | Transistor |
| Q6 | 2N2907A | PNP | Transistor |
| Q7 | 2N2222A | NPN | Transistor |
| Q8 | 2N2907A | PNP | Transistor |
| Q9 | 2N2222A | NPN | Transistor |
| Q10 | 2N2907A | PNP | Transistor |
| Q11 | 2N2222A | NPN | Transistor |
| Q16 | 2N2222A | NPN | Transistor |
| Q17 | 2N2907A | PNP | Transistor |
| Q18 | 2N2222A | NPN | Transistor |
| Q19 | 2N2907A | PNP | Transistor |
| Q20, Q21, Q22, Q23 | 2N2222A | NPN | Transistor |
| Q24 | D41D1 | PNP | Transistor |
| Q25 | 2N2222A | NPN | Transistor |
| Q26 | 2N2907A | PNP | Transistor |
| Q27 | 2N2222A | NPN | Transistor |
| Q28 | 2N2907A | PNP | Transistor |
| Q29 | 2N2222A | NPN | Transistor |
| VR1 | 340T-5 | +5 volts | Regulator |
| VR2 | 340T-12 | +12 volts | Regulator |
| VR3 | 320T-12 | -12 volts | Regulator |

SOCKET BOARD

| | | | |
|---|---|---|---|
| CR28, CR29 | 1N4001 | | Diode |
| SW1 | SPDT | | Switch |

COMPONENT CIRCUIT SYMBOL

NOT USED:

R7, R21, R22, R23, R24
CR6, CR8, CR16, CR17
Q12, Q13, Q14, Q15

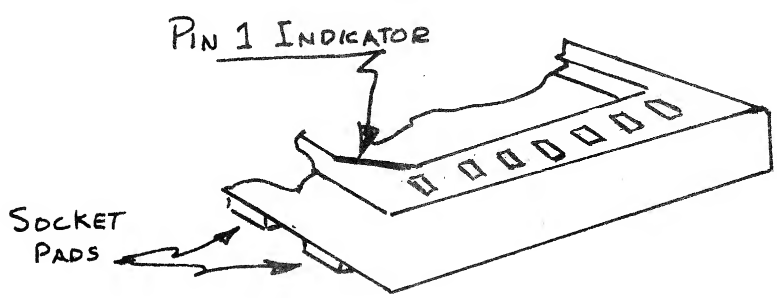
LAST NUMBER USED: U19 R47 C14 CR27 Q29 VR3

(D) When inserting electrolytic capacitors, be careful to align the polarities correctly. Incorrect direction will damage components.

(E) Diodes and zener diodes must be properly inserted to prevent damage to components.

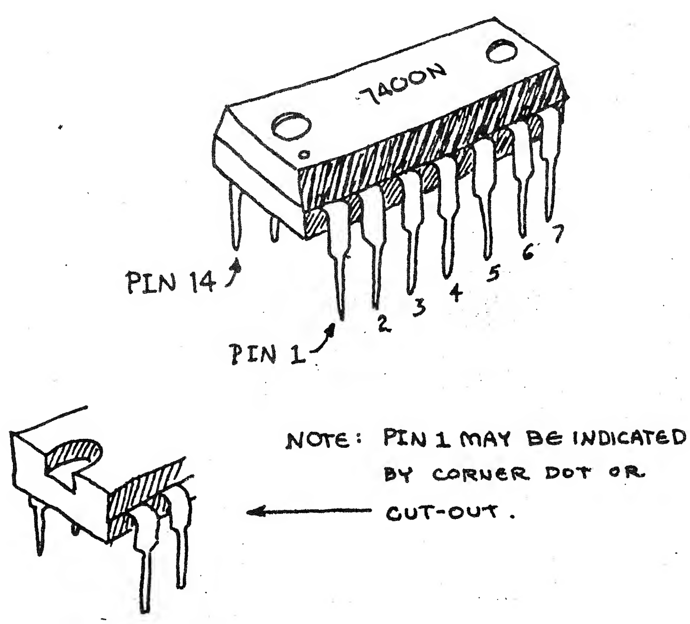
2.1.1 Dual In-Line Sockets

The IC sockets are designed with a small corner section that can be used to indicate the position of pin 1.




Place the socket so that Pin 1 Indicator aligns to the pin 1 of the PC board. Insert the socket from the front side onto the board and, while holding it flush on the board, solder (from the rear of the board) only the two opposite end pins. Then check that the socket pads are flush to the board. If a large gap exists under the socket pads, reheat the pins and, at the same time, push down on the socket to obtain a flush condition. Once the socket is flush, solder the rest of the pins. Always inspect your soldering joints to be sure that the solder is smooth with no eruption outgassing holes and that there is not an excessive amount of solder. Check that no short was made to adjacent circuit printed wiring lines.

The plastic Dual In-Line Package (DIP) integrated circuits indicate pin 1 of the package by a dot or cutout as shown below.



DO NOT insert the DIP IC's until the +5 volt regulator has been installed and tested. When inserting the IC, make sure no pin is accidentally bent under the package instead of going into the socket.

A DIP IC insertion tool would prove helpful for inserting and removing the IC from the sockets.

Printed Circuit (PC) Dual In-Line Layout IC U1 through U12, U18 and U19 all have their pin 1 located at the bottom. IC U13 through U17 have their pin 1 located to the left. These positions are in relation to the view when looking at the front of the board with the 100-pin edge connector at the bottom.

## 2.2 ASSEMBLY - MAIN MODULE BOARD

The following assembly procedures are written in logical steps. Variation of these steps is permitted, although consideration should be given to any impact that a change in the sequence may have.

The Address and Data circuits A through H (center top of the board) components are called out as R1A, R1B, etc.

ALL COMPONENTS ARE INSERTED FROM
THE FRONT OF THE BOARD.

### 2.2.1 Assembly Procedure

STEP 1. DIP Sockets Installation

There are five (5) 14-pin DIP sockets and fourteen (14) 16-pin DIP sockets. Install these sockets using the procedure outlined in the General section, 2.1.1.

STEP 2. Jumper Installation

There are five (5) Jumpers located at the upper-half center of the PC board. These jumpers are labeled A, B, C, D, and E, as seen from the rear of the board (see

Working from the rear of the board, insert a piece of solid 22- or 24-gauge wire into one of the jumper points and solder. Slip a piece of sleeving over the wire and insert the open end into the other jumper point having the same letter. Push the wire flat and solder from the front of the board. Then trim the wire as close as possible to the board. This is necessary so that the components above the jumper pads can be placed close to the surface of the PC board to make a professional-looking product.

Repeat this procedure until all five jumpers are in position.

STEP 3A. TO-18 Transistor Installation - General Information

There are two types of TO-18 transistors used. These are:

| | | |
|---|---|---|
| 2N2222A | NPN | Positive (P) type |
| 2N2907A | PNP | Negative (N) type |

To assist in proper transition location, a letter "P" is placed near the 2N2222A transistor and a letter "N" is located near the 2N2907A.

Take enough time during this procedure to insure you have selected the appropriate transistors before soldering. This would save you a lot of frustration and is well worth the extra time that you will invest.

The transistor pin connections, looking from the bottom (see picture below), reading clockwise and starting from the tab, are emitter (e), base (b), and the collector (c).


The transistor must NOT be placed directly flush on the board; otherwise, shorts of printed wiring may occur. Also, this will make it difficult to remove a transistor if it becomes necessary. Plastic pads are supplied for each TO-18 transistor. These pads are placed under the transistor before insertion. These pads must be used or an equivalent clearance must be given under the transistor; otherwise, the warranty may be invalidated.

STEP 3B. TO-18 Transistor Installation

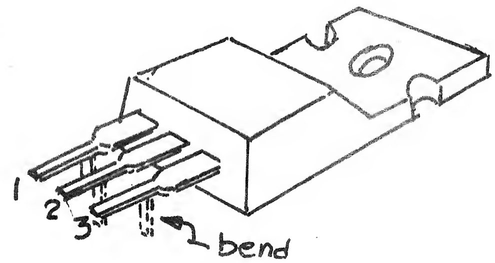
Install the transistors from the front of the board in their proper locations. Before installation, place the plastic pad supplied under the transistor. Push the transistor down so that it is in contact with the pad and so that the pad is in contact with the board, then solder one lead, from the rear of the board. Check the positioning of the transistor and that its alignment is such that it would not touch any transistors in its vicinity. If necessary, reheat the lead and readjust the transistor. When satisfied, solder the other two leads, then trim the leads from the rear side close to the board.

STEP 4A. IC Regulator - General Information

There are three IC voltage regulators in the TO-220 case. These are (other equivalent part numbers may be substituted):

| | | |
|---|---|---|
| VR1 | 340T-5 | +5 volts |
| VR2 | 340T-12 | +12 volts |
| VR3 | 320T-12 | -12 volts |

The positive regulator (340T) pins are from left to right (see drawing below): INPUT (Pin 1), GROUND (Pin 2), OUTPUT (Pin 3). Note that the metal tab is at the same potential as Pin 2. The negative regulator (320T) pins are GROUND (Pin 1), INPUT (Pin 2), OUTPUT (Pin 3). The negative regulator tab will have a negative potential, and care should be taken not to short this part of the regulator case.




As a note, do not confuse the PNP D41D1 transistor with the voltage regulator (see Step 7A for information about this transistor).

STEP 4B. IC Regulator - Installation

The three regulators are located on the left side of the board. Select the appropriate regulator and bend the leads as shown above to fit the pad layout on the PC board. Repeat this procedure for all three regulators.

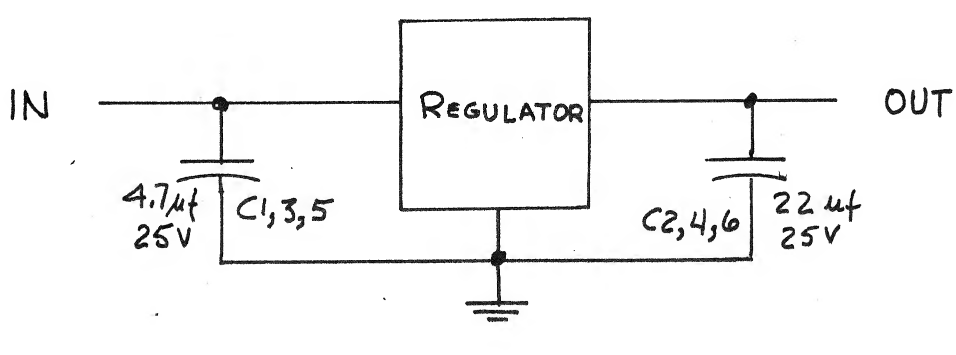
Insert the IC and put a 6-32 3/8 screw from the rear of the PC board. Adjust the leads, if necessary. Install a ~~flat washer and an~~ internal tooth lockwasher before putting the nut on.

The positive +5V (VR1) regulator uses a heat sink. Once the +5V regulator has been inserted and adjusted, remove the screw and slide the heat sink between the PC board and the regulator. Then insert the screw again as given above. Place another screw, also from the rear, in the second hole of the heat sink and add the washers and nut. Torque all the nuts down.

Once the IC regulators are installed, then solder the leads. If necessary, trim the leads from the rear side close to the board.

STEP 5A. Filter Capacitor - General Information

There are two filter capacitors for each voltage regulator. The typical circuit is shown below.



The polarity of these filter capacitors must be observed. The capacitors are marked indicating the polarities. Depending on the manufacturer of the capacitor, either the positive or negative leads are indicated. Sometimes, the polarity of the capacitor can be determined by inspection. In general, the negative end of the capacitor is the metal part of the capacitor can.

STEP 5B. Filter Capacitor - Installation

Take three (3) 4.7 μf and three (3) 22 μf capacitors and bend their leads to a 3/4-inch separation. Insert the capacitors from the front of the board in their proper location and proper polarities. Hold the capacitor onto the board and, from the rear of the board, solder the leads. Trim the leads from the rear side close to the board.

STEP 6. Test Voltage

A) Insert the main module into the S-100 bus. Using a dc voltmeter, connect across capacitor C2. Turn on the computer and measure the voltage. Record the results below.

+5 volts [ ] +4.8 to +5.3 volts

If the voltage is more or less than the limits indicated, turn the power off and go to Troubleshooting, Section 4.1.

B) Repeat the above for the +12 volts, using capacitor C4.

+12 volts [ ] +11.5 to +12.7 volts

C) Repeat the above for the -12 volts, using capacitor C6.

-12 volts [ ] -11.5 to -12.7 volts

STEP 7A. D41D1 Transistor - General Information

The PNP transistor (D41D1) pins are, from left to right (see drawing below): emitter, base, collector.

Note that the collector is indicated by the chamfer of the plastic case and the metal tab is internally connected to the collector. Care should be taken not to short this metal tab.

STEP 7B. D41D1 Transistor - Installation

Bend the leads as shown in the drawing above to fit the pad layout on the PC board. Hold the plastic case against the PC board and bend the metal tab so that it lies flat against the PC board. Insert a 6-32 x 3/8 screw from the rear of the PC board. Adjust the leads, if necessary. Install a flat washer and an internal tooth lock washer before putting on the nut. Torque the nut down and solder the three leads. If necessary, trim the leads from the rear side close to the board.

STEP 8A. Resistor - General Information

All resistors used are 1/4 watt size. The leads are bent close to the body, which should give a distance of 0.35 inches. This is the PC board spacing.

The following resistors are omitted in this step. They are inserted after further testing in later steps (see Step 14).

R9
R16
R40

STEP 8B. Resistor - Installation

Refer to the component layout shown in Figure 30 and the schematic shown in Figure 31.

Select the appropriate resistor for the position and insert the resistor from the front side of the board. Solder the leads and trim from the rear side of the board.

Start with the Address and Data circuits. Begin with Address circuit A, component R3A, top line; insert and solder the 10k resistor. Continue with the next resistor, R3B, two pads to the right, repeating the soldering process. This will continue until R3H has been inserted. Now jump over to the Data circuit H, component R6H, top line, second pad over. This is the pad going to top connector pin 11. Repeat the process above. Continue through R6A, and then to the programmer circuit R46.

SEE ERRATTA for R6A + B

Repeat all the above for R2A, 2.2k, located at the center row. Continue through R2H, then to R5H through R5A and R45.

Repeat all the above for R1A, 680Ω, located at the bottom row. Note that the pad arrangement is different, having only the single circuit element in this row. Continue for R1H and then R4H through R4A and R44.

Next, do the six Address Select resistors, R8A through R8F, to the left of IC U5.

All of the rest of the resistors are located on the right-hand side of the board. Repeat the installation as described above.

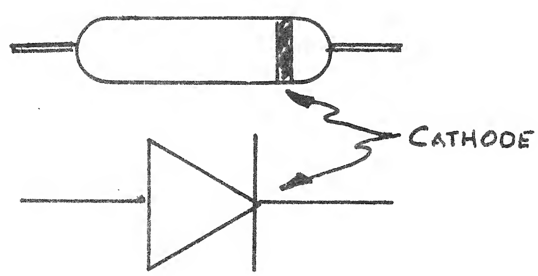
ERROR

There is an error calling out a diode which is resistor R20. This is located in the upper part of the right-hand side of the main module board just below R13. The circuit symbol is shown as CR8 but should be R20, which is a 2.2k-ohm resistor. Make sure to install this resistor.

STEP 9A. Diode - General Information

All the diodes are 1N4001 (alternate series of equivalent diodes may be substituted). The diode leads are bent to the same spacing as the resistors, which is 0.35 inches. Be careful not to mix these diodes with the zener diodes.

Care must be taken to insure that the diodes are installed in the proper direction. Follow the schematic for polarity indication. The band on the diode indicates the cathode end, as shown below.




To assist in installation, a bar was placed on the PC board, next to the connection which takes the cathode. (Only one indication is given in the Address and Data section. All the Address and Data diodes are placed in the same direction.)

STEP 9B. Diode - Installation

Start with the Address and Data circuits. Install from the front of the board with the diode cathode facing up. Beginning with Address circuit A, component CR2A, insert the diode, pushing down on the PC board. Solder the leads and trim from the rear of the board. Continue with the next diode, CR2B, two pads to the right, repeating the soldering process. This will continue until CR2H has been inserted. Now, jump over to the Data circuit H, component CR5H, top line, first pad. This is the pad to the left of the resistor which went to the top connector pin 11. Repeat the process through CR5A and CR27.

All the rest of the diodes are located on the right-hand side of the board. Repeat the installation as described above.

ERROR

There is an error calling out a diode which is a resistor. The circuit symbol is shown as CR8 on the main module board. This is located in the upper part of the right-hand side of the board just below R13.

The resistor is a 2.2k-ohm R20, which is placed into the location called CR8.

The resistor installation is given in Step 8B. If R20 (above) was not installed at that time, place this resistor into the pads called out as CR8.

STEP 10. Bypass Capacitor - Installation

There are six (6) bypass capacitors. All the bypass capacitors are 0.1 mf. Insert these capacitors into circuit elements C8, C10, C11, C12, C13 and C14.

The capacitor leads will have to be formed properly so that no short circuits may occur. This is especially true for C9, C13, and C14. Additional care must be taken with bypass capacitor C14. The capacitor should be centered over the feedthrough pad. Note that this capacitor is connected between the right side of the Address Select resistor pads and the right side of the Address Select jumper pads.

STEP 11A. Address Select - General Information

Place jumpers across selected address for A2 through A7. (NOTE: At least one jumper must be used; otherwise, it would have the address FF, which is used within the computer.)

A six-pole DIP switch can be used, if you wish.

Information about the selection process is covered in Section 3.2.2.

STEP 11B. Address Select

From the front of the board, solder a piece of 22- or 24-gauge wire at the selected address pads for A2 through A7.

STEP 12. Insert DIP IC's

Insert DIP IC U1 through U19. Reread Section 2.1 for pin location and caution when inserting the IC's.

STEP 13. Test IC Operation

Place the module board on a card extender, which is inserted into the S-100 bus. Use an IC test probe to read signals existing at the IC pins. During these tests, a "1" would be a voltage over 3.0 volts. A "0" would be a voltage of 0 to about +0.5 volts.

If improper operation occurs, refer to the Troubleshooting Section, IV.

A) Test Voltage

Repeat Step 6 above.

B) Test Address Enable

Place the IC test probe on U4 (8131) and connect a voltmeter between Ground and Pin 9. Turn on the computer.

The voltmeter should read a "1". Set the program for output port address selected as follows:

D B<br>
X X<br>
Ø Ø

where XX is the selected address. Single step the program to open the output port. At this point, the voltage should go to a "0". Advance the program one step and the enable line (Pin 9) should go back to a "1".

C) Test Address Select

Place the IC test probe on U2 (74155). Measure the voltage on Pins 4, 5, 6, 7, 9 and 10. All of these voltages should be a "1". Now move the IC test probe to U1 (74Ø4). Measure the voltage on Pins 2, 4, 6, 8, and 1Ø. All of these voltages should be a "0".

Replace the IC test probe to U2. Set address select $A_1$ and $A_0$ to "0" and step the program for opening the output port. Pin 4 should go to "0". Continue as shown in the following table.

| | | U2 | | | | | | U1 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $A_1$ $A_0$ Pin | 4 | 5 | 6 | 7 | 9 | 10 | 2 | 4 | 6 | 8 |
| D3 | Ø | Ø | 1 | 1 | 1 | 1 | 1 | 1 | Ø | Ø | Ø |
| | 1 | 1 | 1 | Ø | 1 | 1 | 1 | Ø | Ø | 1 | Ø |
| | 2 | 1 | Ø | 1 | 1 | 1 | 1 | Ø | 1 | Ø | Ø |
| | 3 | 1 | 1 | 1 | Ø | 1 | 1 | Ø | Ø | Ø | Ø |
| DB | 1 | 1 | 1 | 1 | 1 | 1 | Ø | Ø | Ø | Ø | Ø |
| | 3 | 1 | 1 | 1 | 1 | Ø | 1 | Ø | Ø | Ø | 1 |

In tests D) through G), refer to the following table.

| | Pin Connector | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3E | 1 | 8 | 11 | 14 | 9 | 10 | 15 | 16 |
| Data (D) U16 | ØØ | Ø | Ø | Ø | Ø | 1 | 1 | 1 | 1 |
| | FF | 1 | 1 | 1 | 1 | Ø | Ø | Ø | Ø |
| Address (E) U14,U15 | ØØ | Ø | Ø | Ø | Ø | 1 | 1 | 1 | 1 |
| | FF | 1 | 1 | 1 | 1 | Ø | Ø | Ø | Ø |
| Address (F) U13 | ØØ | Ø | Ø | Ø | Ø | 1 | 1 | 1 | 1 |
| | FF | 1 | 1 | 1 | 1 | Ø | Ø | Ø | Ø |
| Control (G) U9 | ØØ | Ø | Ø | Ø | Ø | 1 | 1 | 1 | 1 |
| | FF | 1 | 1 | 1 | 1 | Ø | Ø | Ø | Ø |

LATCH TABLE

D) Test Data Latch (74L75)

The data latch is set when $A_1$ and $A_0$ are set to "3". Expand the program to set "A" first to ØØ and then to FF.

```
3E
ØØ
D3
XX
ØØ
```

Single step through the program.

Place the IC test probe on U16 and U17. Test pins 1, 14, 11, and 8. With "A" set to ØØ, the output should be "0" on all pins. Change the program "A" to FF. Single step through the program. Remeasure pins 1, 14, 11, and 8. The output should be "1" on all pins. $>$2,4VDC

E) Test Address Latch (Lower)

The lower address latch is set when $A_1$ and $A_0$ are set to "1". $>$2.4V Repeat the above procedure (D) except using U14 and U15, pins 16, 15, 10, and 9; set "A" to FF first.

F) Test Address Latch (Upper)

The upper address latch is set when $A_1$ and $A_0$ are set to "2". Repeat procedure D) for pins 11 and 8 only, except using U13; set "A" to ØØ first.

G) Set Control Latch

The control latch is set when $A_1$ and $A_0$ are set to "Ø". Repeat the above, except using U9, pins 1, 14, 11, and 8; set "A" to ØØ first.

H) Test Control Logic

Place the IC test probe on U12. Pins 4 and 11 are at VCC (+5 volts) and pin 10 should be at "1".

In the following, $A_1$ and $A_0$ are set to "Ø". Set "A" to Ø8, 3E, 08, and step through the program given in procedure D). Pin 3 of U12 should be "0". Pins 6 and 12 should be "1" and pin 8 should be "0".

Set "A" to ØØ and step through the program. Pin 6 should still be "1", but pin 12 should now be "0".

Momentarily short pin 10 to Ground (be careful that it is pin 10). Pin 6 should now go to "0" and pin 12 should go back to "1". You now have tested the over current latch logic.

Repeat the program first with "A" set to Ø8 and then to ØØ. Now move the test probe to U10. Pins 6, 8 and 11 should be "1". Move the test probe to U11. Pins 6, 8 and 10 should all be "0" and pin 12 should be "1".

Set A to Ø7. With the test probe on U11, pins 6, 8, 10 and 12 should all be "1".

STEP 14A. Resistors R9, R16, R20 - General Information

These three resistors are all in the high voltage generator circuits. If an abnormal operation occurs, due to failure of some circuit component, then excessive wattages could be produced in these resistors, resulting in the generation of heat and the destruction of the resistors.

To make replacement of these resistors easy and to prevent discoloring of the printed circuit board, it is suggests that these resistors be placed OFF the board by a little more than one-half of the body diameter (about 1/16 inch).

STEP 14B. Resistors R9, R16, R40 - Installation

Select the appropriate resistor for the position and insert the resistor from the front side of the board. Solder the leads and trim

from the rear side of the board. Make sure the resistor is <u>not</u> down in contact with the board.

Repeat the above procedure until all three resistors are in place.

STEP 15A. Capacitors C7 and C~~8~~9 - General Information

These two capacitors are the pulse capacitors used in the high voltage generation circuits.

STEP 15B. Capacitors C7 and C~~8~~9 - Installation

Select the appropriate capacitor for the position and insert the capacitor from the front side of the board, making sure that the polarity is correct. Repeat the above for the second capacitor.

Looking at the front of the board with the 100-pin connector at the bottom, the C7 negative side is on the right side and the C~~8~~9 negative side is on the left side.

STEP 16A. Zener Diode - General Information

There are five different types of zener diodes used. These are:

Low Power

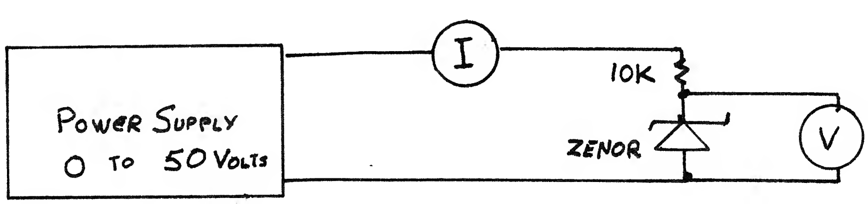
| | |
|---|---|
| 1N5223 | 2.7 volts |
| 1N5240 | 10 volts |
| 1N5254 | 27 volts |
| 1N5261 | 47 volts |

High Power

| | |
|---|---|
| 1N5342 | 6.8 volts |

(Alternate series of equivalent diodes may be substituted.)

If, for some reason, the identification of the diode is obscured, the actual value can be measured utilizing the circuit given below.



Starting from 0, increase the power supply voltage until a further increase in supply voltage causes only a very small change in the voltmeter placed across the zener. If a current meter is available and placed in the main supply lead, then zener action can be noted when there is a sharp increase of the supply current as the voltage is increased. The voltmeter reading is then the zener voltage. Note that this voltage may be a few volts lower than the stated zener voltage. This is due to the fact that the current drawn by this circuit can be lower than the rated test value.

STEP 16B. Zener Diode - Installation

Start with the Address and Data circuits. Install from the front of the board with the cathode facing down. Beginning with Address circuit A, component CR1A, inser the diode, pushing down on the PC board. Solder the lead and trim from the rear of the board. Continue with the next diode, CR1B, two pads to the right, repeating the soldering process. This will continue until CR2H has been inserted. Now jump over to the Data circuit H, component CR4H, center line, second pad. This pad is to the right of R5. Repeat this process through CR4A and CR26.

Next install zener diode 1N5342 into location CR3. The component location is located to the left of the top row of the Address group. This device can be distinguished from the other zener diodes by its larger body diameter.

All the rest of the zener diodes are located on the right-hand side of the board. Repeat the installation as described above.

STEP 16C. Test CR3 Voltage

Place the main module board on a card extender which is inserted into the S-11 bus and turn the computer ON. Using a dc voltmenter, measure the voltage output from the diode (pin CC of top connector) to Ground. The voltmeter should read about -6.5 volts (with no load).

STEP 17. Test Pulse Voltage Generator

Place the main module board on a card extender which is inserted into the S-100 bus. Place the 50-pin edge connector on the top board connector.

At this point, an oscilloscope would prove helpful. A dc voltmeter (10,000 ohms per volt or better) is necessary to properly test the board operation. In the following, the voltmeter has one lead attached to the board Ground. If an oscilloscope is used, it is also grounded to to the board Ground.

Care must be taken not to accidentally short circuit the voltage being measured.

Turn the computer ON and follow the steps given below.

Set the following program. This program turns OFF both Address and Data busses for this portion of the test.

F0=240
1
2
3

| | | |
|---|---|---|
| 000Ø | 3E | Turn OFF DATA |
| 0001 | ØØ | |
| 0002 | D3 | |
| 0003 | F3 | |
| 0004 | 3E | Turn OFF ADDRESS |
| 0005 | FF | |
| 0006 | D3 | |
| 0007 | F1 | |
| 0008 | 3E | Reset Latch |
| 0009 | Ø8 | |
| 000A | D3 | |
| 000B | FØ | |
| 000C | 3E | Set Charge |
| 000D | ØØ | |
| 000E | D3 | |
| 000F | FØ | |
| 001Ø | Ø5 | Delay |
| 0011 | C2 | |
| 0012 | 1Ø | |
| 0013 | ØØ | |
| 0014 | 3E | Set Pulse |
| 0015 | Ø7 | |
| 0016 | D3 | |
| 0017 | FØ | |
| 0018 | Ø5 | Delay |
| 0019 | C2 | |
| 001A | 18 | |
| 001B | ØØ | |
| 001C | C3 | |
| 001D | ØC | |
| 001E | ØØ | |

Run this program and make the following measurements:

A) 2708 Positive Pulse

Now attach a voltmeter to capacitor C7 positive lead. You can use pin 1 of the top connector. Meter should read about +12.5 volts. Move the lead to the negative lead of C7. The meter should read about -1.2 volts. Waveform C7 positive lead is about Ground to +27 volts peak.

B) Negative Pulse

Attach the voltmeter to capacitor ~~C8~~ C9 negative lead. Meter should read about -30 volts. Move the lead to the positive lead of ~~C8~~ C9.

The meter should read about -1.2 volts. Waveform C~~8~~9 negative lead is about -16 volts to -47 volts peak.

C) 1702A Program Pulse

Attach the voltmeter to program pulse output, pin E, of the top connector. The meter should read about -22 volts. Waveform should read about Ground to -47 volts peak.

D) 1702A $V_{DD}$ Pulse

Attach the voltmeter to $V_{DD}$ pulse output, pin 2 of the top connector. The meter should read about -28 volts. Waveform should read about -9 volts to -47 volts peak.

E) 1702A $V_{GG}$ Pulse

Attach the voltmeter to $V_{GG}$ pulse ouptut, pin 3 of the top connector. The meter should read about -23.5 volts. Waveform should read about -9 volts to -37 volts peak.

F) 1702A Address Pulse

Attach the voltmeter to each of the Address pulse outputs, one at a time: pins T, U, V, W, X, Y, Z, and AA. The meter should read about zero.

Set program step 0005 to ØØ and run the program from the start.

Repeat the above. The meter should read about -19 volts. Waveform should read about Ground to -47 volts peak. Reset step 0005 to FF.

G) 1702A Data Pulse

Attach the voltmeter to each of the Data pulse outputs, one at a time: pins 4, 5, 6, 7, 8, 9, 10, and 11. The meter should read about zero.

Set program step 0001 to FF and run the program from the start.

Repeat the above. The meter should read about -19 volts. Waveform should read about ground to -47 volts peak.

This completes the circuit testing procedure. Upon successful results, your Prom Setter will operate properly.

## 2.3 ASSEMBLY INTERCONNECTING CABLE

The Interconnecting Cable connects the main module board of The Prom Setter to the back of your computer. It uses the same ribbon cable as is used with the socket board.

There are three DB25S (female) connectors used to arrange the Prom socket pin connectors and signals for operating the 1702A and 2708.

The other end of the cable is attached to a 50-pin connector (50-50EE-30), J2. This connector is a dual 25-pin type and is labeled 1 through 25 and then A through Z and AA, BB, CC with the following letters not used: G, I, O, Q.

Pin connections of J2 are given in Figure 1. The three rear connectors (DB25S type) J3, J4, and J5 pin connections to J2 are given in Figure 2.

Assembly is accomplished by first attaching the ribbon cable to connectors J3, J4, and J5, then making the cable run to connector J2. Enough cable should be used to allow your Prom Setter module to operate when placed on an extender board.

There are two types of DB25 connectors that may be supplied with each kit. These connectors are either one in which the pins are molded into the connector body or one where the pins are removable from the body of the connector. Both types will perform identically, although they require different assembly procedures.

### 2.3.1 Removable Pin Connector

The pins of this type of connector are inserted and removed using a special tool that is supplied with the kit. Only light force is required when using this tool. The tool is made of plastic and excessive force may destroy the thin end. A slit along the length of the tool will allow the wire to enter into the center of the tool.

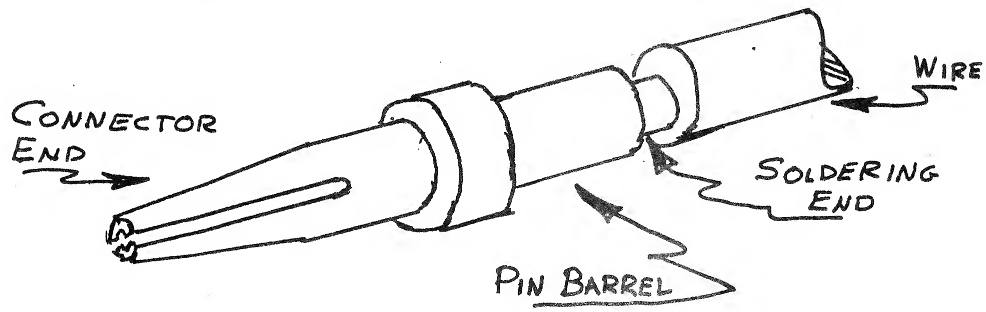
To remove an inserted pin, push the tool's thin end into the connector body from the wire side. Then from the other side, push the pin out. For the female pin, a small paper clip will prove useful as a pushing tool.

To insert a pin, place the thin edge of the plastic tool against the ridge of the connector pin from the wire side. Then push the pin into the connector body. This should require only a light force. Once the pin is properly inserted, the plastic tool is slid back along the wire and then removed by allowing the wire to pass through the slit along its length.

<u>CAUTION</u>

Before soldering a wire to the connector, make sure you are operating from the proper end. The connector side has two slits. The wire

soldering end has the shorter barrel as shown below.




Care should be taken to prevent excessive solder forming around the pin barrel. UNDER NO CIRCUMSTANCES should solder be allowed to flow onto the connector side of the pin; otherwise, the connector pin may be destroyed.

NO SLEEVING is used when assembling this type of connector.

2.3.2 Fixed Pin Connector

The pins of this type of connector are molded into the connector body and are not removable.

Before soldering the wire to the connector, a short piece of shrink tubing (about 3/8 inches) is placed over the wire. Once all the wires are soldered into place on the connector, the tubing is pushed down all the way so that it covers the rear pin. Be careful not to have excessive solder on the outer surface of the connector pin. The tubing supplied is heat-shrink type and requires heat of over 250°F to cause the tubing to shrink. A heat gun is normally used to shrink the tubing. You can try a 1000-watt hairdryer. An alternate method is to place the connector assembly into a preheated 250°F oven for about two (2) minutes. Repeat this process if necessary.

DO NOT OVERDO the oven heating; otherwise, components may be damaged. Use the largest size tubing for pins which hold two wires.

STEP 18A. Interconnecting Cable Assembly - General Information

The ribbon cable supplied has 15 wires. The cable is color coded, starting with brown, going through white, and then continuing with black through green. Assign the color code number as brown = 1, red = 2, etc. Write the color code number on the figures as connections are made to the DB25 connectors.

Assembly of the wire to the connector is accomplished by first trimming the wire insulation back for about 3/8 inch. Then twist the wire smooth and tin the end. Then cut the wire back (about 1/8 inch) to fit flush into the connector pin. When two wires are used in a single connector

pin, follow the above procedure except twist both wires together before tinning the end. Do not use more than two wires per pin.

A small vise may prove helpful when soldering the connector pins.

Solder the DB25S sockets first, then make the run to the main module board connector J2.

Suggested arrangement of the three DB25 connectors is to put the 1702A Write (J3) first, followed by the 1702A Read (J4), and then the 2708 Read/Write (J5).

Note the front side of the main module J2 has numeric pins and the rear connector pins are letters.

STEP 18B. 1702A Write Connector J3

Take the ribbon cable and strip all wires from the wire next to it for about 1-1/2 inch. Continue to strip back the two end wires colored green and yellow for about two feet. This will leave thirteen (13) wires on the ribbon cable. Use the removed two wires for interconnect jumper on the connector.

Starting with the first wire (brown), twist together with a jumper wire about 4 inches long and solder to connector pin 1. Take the second wire (red) and solder this single wire to pin 2 of the connector. Continue this procedure for the rest of the pins except for pin 7 (Write Disable control) which has a jumper wire as was accomplished for pin 1.

Now take the other end of the ribbon cable, repeating the above stripping, except this time continue to strip back the first three wires for about two feet. These are brown, red and orange wires.

Starting with the first wire (yellow), solder this single wire to pin 14 of the connector. Continue making pins 15 and 17 having jumper wires. Attach the rest of the wires till pin 23 is reached.

Take the jumper wire attached to pin 1, leaving a service loop, make a second jumper wire and solder to pin 23 and then to the second jumper and soldered it to pin 24.

Take the next wire of the ribbon cable and solder it to pin 25 of the connector. In this process, the wire color code will represent the pin connection (except for the last connection made) and assist in connection to J2.

Remove the outside two wires not used in the above procedure.

Now temporarily attach the connector to the back of the computer and make the two pieces of ribbon wire run as neat as possible and as it will be used in the computer. Remember to leave enough service loop to permit the main module board to be operational when placed on an extender board.

Let the wire cable extend about two inches beyond the connector J2 and cut the cable. NOTE: The direction of the cable is determined by your computer and where the DB25 connector is placed.

STEP 18C. 2708 Read/Write Connector J5

With this connector, almost all the pins have two wires attached to them. The only single wires are

19, 20, 21, 22, 23, 24 .

Repeat the process as outlined in Step 18B. Starting with the first wire (brown), twist together with a jumper wire and solder to connector pin 1. All jumpers are used to connect to J4 and should be about 4 inches long. Repeat this process until connector pin 13 is reached. Then continue with a second ribbon cable as was given in Step 18B. Starting with the first wire (yellow), continue the operation until pin 25 of the connector is soldered.

As in Step 18B, temporarily attach the connector to the back of the computer and run the two ribbon cables to connector J2 of the main module. Cut the cable as before.

STEP 18D. 1702A Read Connector J4

This connector uses the jumpers from both J3 and J5. At this point, there should be four (4) jumpers from J3 as follows:

| Pin J3 | | Pin J4 |
|---|---|---|
| 7 | Disable | 7 |
| 13 5 | Ground | 13 5 |
| 17 | $V_{GG}$ | 17 |
| 25 | $V_{DD}$ | 25 |

and from J5 there are 19 jumpers. These are all pins <u>except</u> 19, 20, 21, 22, 23, and 24.

Most of the jumpers are single wires soldered to connector J4. The following pin connections of J4 are wire pairs:

7, 14, 15, 16, 23, 24

Starting with the jumpers from J5, connect all the single jumpers. A wire connection table for J4 from J3 and J5 is given in Figure 2.

STEP 18E. 50-Pin Main Module Connector J2

Temporarily attach the three connectors J3, J4 and J5 to the back of the computer. You now have four ribbon cables coming from the connectors, going to J2. Make the ribbon wire run as before.

Take the ribbon cable and strip all wires from the wire next to it the full length of connector J2 and about one inch further. Mark the main cable (from J3 and J4) and lace the cables together, about one inch beyond where the wires were separated from each other. Then remove the cable and J2 from the computer. This will make it easier to work and will insure that no damage will occur to your computer due to solder droppings.

All pins take a single wire except pins 13 and A. These two pins have wires coming from J3 and J5.

A small vise may prove helpful when soldering the connector pins. Place connector J2 into the vise with the wire soldering connections facing up and the top of the body about at the top jaws of the vise. Do not put too much pressure; otherwise, the connector may be broken.

Bend the pins 90 degrees, starting about 1/32 of an inch above the connector body.

Cut 1/2-inch lengths of heat shrink tubing. Starting with the shortest cable length (either J2, pin 1/A, or J2, 25/CC, depending on the direction the cable is coming from)

Hold the cable in place and cut the shortest connecting wires, leaving about 1 inch extra length. Then trim the wire insulation back for at least 1/2 inch. When two wires go to the same pin, they can be either put on one at a time or both twisted together. Twist smooth and tin the wire end and cut back to about 1/4 inch. Slide a piece of heat-shrink tubing over the wire. When two wires are used, both wires should be put into one piece of tubing. Mechanically attach the wire to the connector lug. Solder the wire to the lug, making sure that the heat shrink tubing will slide down over the lug all the way.

Repeat the above procedure until all connections are made. Figure 1 gives the wire interconnections to J2.

After completion of all soldering, using an ohmmeter or other continuity measuring device, carefully check all connections to make sure proper connection was made and no shorts exist.

Slide all the heat shrink tubing down onto the connector lugs and shrink the tubing (see paragraph 2.3.2 for methods of shrinking the tubing).

STEP 18F. Install Connecting Cable

Permanently install the three DB25 connectors. Use lacing string to form the ribbon cable run as required to make a professional run. The connectors are held in place with 6-32 x 1/2-inch screws. Use a flat washer followed by the internal tooth lock washer and then the nut. Torque the nut down. Clean up the 50-pin connector J2 with lacing string.

## 2.4 PROM SOCKET BOARD ASSEMBLY

You have now completed the assembly of the main module. The next series of steps is to assemble the socket board.

Looking at the back side of the PROM socket board TPS-200, you will note a tape placed on the board. DO NOT REMOVE THIS TAPE. The tape is a special high temperature insulating tape to assist the assembly processes.

### STEP 19A. Interconnecting Cable - General Information

The ribbon cable has 15 wires. The first cable uses 13 leads and the second cable uses 12 leads. The cable is color-coded starting with brown going through white and then continuing with black through green. Assign the color code numbers such as brown = 1, red = 2, etc. Note the pads have no through-holes.

### STEP 19B. Interconnecting Cable - Installation 1

Cut a length of 15-wire ribbon cable about 26 inches long. Strip off the end green and yellow wires. [The cable will now start with a brown wire (1) and end with an orange wire (3)].

Strip all wires back by about 1-1/2 inches. Be careful not to expose the wire from the insulation. Now take the wires starting from each end and trim as an inverted V, "Λ", to fit the layout on the pads on the upper back of the socket board TPS-200.

Trim the insulation back for about 3/16 inch on each wire, being careful not to cut the wires. Twist smooth and, with solder, tin the ends, then cut to about 1/8 inch long. Starting from the left with the first wire (brown), solder the 13 leads to the upper pads.

### STEP 19C. Interconnecting Cable - Installation 2

Cut another length of ribbon cable the same length as used in Step 19B. This time, strip off the first three wires—brown, red and orange. [The cable now starts with yellow (4) and ends with green (5)].

Strip, trim, and solder the wires as was accomplished in Step 19B. Starting from the left with the first wire [yellow (4)], solder the 12 leads to the center pads.

### STEP 19D. Interconnecting Cable - Installation 3

Put a couple of tie wraps through the two back holes on the socket board and around the two ribbon cables.

Hold the cables flat and trim the two ribbons to the same length. Now, strip all wires from the wire next to it for about 1-3/4 inch. Trim the wire insulation back for about 3/8 inch. Then twist the wire smooth

and tin the end. Cut the wire back (to about 1/8 inch) to fit flush into the connector pin.

For Fixed-Pin Connector type, follow the use of heat shrink tubing as given in section 2.3.2. Using an ohmmeter or other continuity measuring device, carefully check all connections to make sure proper connection was made and no shorts exist.

The connector pin interconnections are given in Figure 5.

Once the connector is assembled, fit the plastic cover to the connector.

STEP 19E. Socket Board Rubber Feet

There are four rubber feet supplied with the kit. Push a flat washer down into the center of the rubber foot. This takes a small amount of force and it helps if the flat washer is inserted at an angle. Follow this with a 6-32 nut.

Place an internal lock washer over a 6-32 x 3/8 screw and insert the screw from the top of the socket board into one of the four holes at the corners. Holding the screw in position, place the rubber foot from the back side, small hole, over the screw, then turn the screw until taut.

This is the last step in the assembly procedure.

| Pin J2 (Front) | | Pin J2 (Rear) | | |
|---|---|---|---|---|
| 1 | +Pulse | A | Write Disable | |
| 2 | $V_{DD}$ | B | $V_{CC}$ | 1702A |
| 3 | $V_{GG}$ | C | $\overline{CS}$/WE | 2708 |
| 4 | D0 1702 (A) | D | $V_{BB}$ | 1702A |
| 5 | D1 1702 (B) | E | Prog. Pulse | 1702A |
| 6 | D2 1702 (C) | F | D0 | 2708 (A) |
| 7 | D3 1702 (D) | H | D1 | 2708 (B) |
| 8 | D4 1702 (E) | J | D2 | 2708 (C) |
| 9 | D5 1702 (F) | K | D4 | 2708 (E) |
| 10 | D6 1702 (G) | L | D5 | 2708 (F) |
| 11 | D7 1702 (H) | M | D6 | 2708 (H) |
| 12 | D3 2708 (D) | N | NC | |
| 13 | Ground | P | NC | |
| 14 | +5V | R | +12V | |
| 15 | D7 2708 | S | NC | |
| 16 | A7 2708 | T | A7 | 1702A (H) |
| 17 | A6 2708 | U | A6 | 1702A (G) |
| 18 | A5 2708 | V | A5 | 1702A (F) |
| 19 | A4 2708 | W | A4 | 1702A (E) |
| 20 | A3 2708 | X | A3 | 1702A (D) |
| 21 | A2 2708 | Y | A2 | 1702A (C) |
| 22 | A1 2708 | Z | A1 | 1702A (B) |
| 23 | AØ | AA | A0 | 1702A (A) |
| 24 | A8 | BB | NC | |
| 25 | A9 2708 | CC | -5V $V_{BB}$ | 2708 |

Figure 1. Connector J2 Pin Connection

| Pin | J3 1702A Write | | | J4 1702A Read | | J5 2708 Read/Write | |
|---|---|---|---|---|---|---|---|
| 1 | J2- B | +5/$\phi$ | | J2-14 | +5 | J2-13 | Grd |
| 2 | 11 | D7 | 1702 | 15 | D7 | J | D2 |
| 3 | 10 | D6 | 1702 | M | D6 | H | D1 |
| 4 | 9 | D5 | 1702 | L | D5 | F | D0 |
| 5 | 8 | D4 | 1702 | K | D4 | 23 | A0 |
| 6 | 7 | D3 | 1702 | 12 | D3 | 22 | A1 |
| 7 | A | Disable | | A | Disable | A | Disable |
| 8 | 6 | D2 | 1702 | J | D2 | 21 | A2 |
| 9 | 5 | D1 | 1702 | H | D1 | 20 | A3 |
| 10 | 4 | D0 | 1702 | F | D0 | 19 | A4 |
| 11 | AA | A0 | 1702 | 23 | A0 | 18 | A5 |
| 12 | Z | A1 | 1702 | 22 | A1 | 17 | A6 |
| 13 | Y | A2 | 1702 | 21 | A2 | 16 | A7 |
| 14 | E | Prog | 1702 | 14 | +5 | 12 | D3 |
| 15 | 13 | Grd | | 13 | Grd | K | D4 |
| 16 | D | $V_{BB}$ | 1702 | 14 | +5 | L | D5 |
| 17 | 3 | $V_{GG}$ | 1702 | 3 | $V_{GG}$ | M | D6 |
| 18 | T | A7 | 1702 | 16 | A7 | 15 | D7 |
| 19 | U | A6 | 1702 | 17 | A6 | 1 | Prog |
| 20 | V | A5 | 1702 | 18 | A5 | R | $V_{DD}$ (+12) |
| 21 | W | A4 | 1702 | 19 | A4 | C | $\overline{CS}$/WE |
| 22 | X | A3 | 1702 | 20 | A3 | CC | $V_{BB}$ (-5) |
| 23 | B | +5/$\phi$ | | 14 | +5 | 25 | A9 |
| 24 | B | +5/$\phi$ | | 14 | +5 | 24 | A8 |
| 25 | 2 | $V_{DD}$ | 1702 | 2 | $V_{DD}$ | 14 | $V_{CC}$ (+5) |

Figure 2. Connectors J3, J4, and J5

| Pin | J4 Connector | J3 Jumper Pin | J5 Jumper Pin |
|---|---|---|---|
| 1 | from 14J4 | --- | --- |
| 2 | | --- | 18 |
| 3 | | --- | 17 |
| 4 | | --- | 16 |
| 5 | | --- | 15 |
| 6 | | --- | 14 |
| 7 | (double wire) | 7 | 7 |
| 8 | | --- | 2 |
| 9 | | --- | 3 |
| 10 | | --- | 4 |
| 11 | | --- | 5 |
| 12 | | --- | 6 |
| 13 | | --- | 8 |
| 14 | to 1 from 16J4 | --- | --- |
| 15 | (double wire) | 15 | 1 |
| 16 | to 14 from 23J4 | --- | --- |
| 17 | | 17 | --- |
| 18 | | --- | 13 |
| 19 | | --- | 12 |
| 20 | | --- | 11 |
| 21 | | --- | 10 |
| 22 | | --- | 9 |
| 23 | to 14 from 24J4 | --- | --- |
| 24 | to 23J4 from 25J5 | --- | 25 |
| 25 | | 25 | --- |

Figure 3. J4 Pin Connections

J2 to J3 and J5 Pin Connection

| Pin J2 (Front) | | Color Code | Pin J2 (Rear) | | Color Code |
|---|---|---|---|---|---|
| 1 | 19J5 | | A | 7J3 and 7J5 | |
| 2 | 25J3 | | B | 24J3 | |
| 3 | 17J3 | | C | 21J5 | |
| 4 | 10J3 | | D | 16J3 | |
| 5 | 9J3 | | E | 14J3 | |
| 6 | 8J3 | | F | 4J5 | |
| 7 | 6J3 | | H | 3J5 | |
| 8 | 5J3 | | J | 2J5 | |
| 9 | 4J3 | | K | 15J5 | |
| 10 | 10J3 | | L | 16J5 | |
| 11 | 11J3 | | M | 17J5 | |
| 12 | 14J5 | | N | NC | |
| 13 | 15J3 and 1J5 | | P | NC | |
| 14 | 25J5 | | R | 20J5 | |
| 15 | 18J5 | | S | NC | |
| 16 | 13J5 | | T | 18J5 | |
| 17 | 12J5 | | U | 19J5 | |
| 18 | 11J5 | | V | 20J5 | |
| 19 | 10J5 | | W | 21J5 | |
| 20 | 9J5 | | X | 22J5 | |
| 21 | 8J5 | | Y | 13J5 | |
| 22 | 6J5 | | Z | 12J5 | |
| 23 | 5J5 | | AA | 11J5 | |
| 24 | 24J5 | | BB | NC | |
| 25 | 23J5 | | CC | 22J5 | |

Figure 4. Ribbon Wire Interconnector Pin Configuration

| Plug Connection | | TPS-200 Socket Board | |
|---|---|---|---|
| Pin | Color Code | EPROM Socket Pin | Color Code |
| 1 | | 12 | |
| 2 | | 11 | |
| 3 | | 10 | |
| 4 | | 9 | |
| 5 | | 8 | |
| 6 | | 7 | |
| 7 | | (Write Disable) | |
| 8 | | 6 | |
| 9 | | 5 | |
| 10 | | 4 | |
| 11 | | 3 | |
| 12 | | 2 | |
| 13 | | 1 | |
| 14 | | 13 | |
| 15 | | 14 | |
| 16 | | 15 | |
| 17 | | 16 | |
| 18 | | 17 | |
| 19 | | 18 | |
| 20 | | 19 | |
| 21 | | 20 | |
| 22 | | 21 | |
| 23 | | 22 | |
| 24 | | 23 | |

Figure 5. Socket Board Interconnection Wiring to Connector

# SECTION III

# THEORY OF OPERATION

## 3.1 EPROM INFORMATION

The Prom Setter is used to read and write both the 1702A and 2704/2708 EPROMs.

The 1702A EPROM requires a more complex voltage programming to write this device.

Both 1702A and 2704/2708 EPROMs are cleared using ultraviolet light. Ultraviolet intensity in the 2537Å region of greater than 6 wsec/cm$^2$ should normally clear the EPROMs in about 20 minutes.

When cleared, the 1702A will have "0" in all data positions, while the 2704/2708 will have "1" in all data positions.

Both EPROMs are written using a program pulse.

One pass through all addresses (page length) to be programmed is defined as a program loop. The number of loops (N) required is a function of the applied program pulse width ($t_{PW}$) and the amplitude of the program pulse voltage. Typical value for programming the EPROM at the specified normal operating voltages for each address is

$$N \cdot t_{PW} \geq 100 \text{ ms}.$$

This time may extend tenfold when low programming voltage is applied to the EPROM.

Due to the high power applied to the 1702A during programming, it is advisable to have a pulse duty rate less than 20%, that is, to program the pulse on for two time periods out of a ten time period cycle.

Both the 1702A and 2704/2708 have their Address and Data bus presented in parallel before the program pulse is applied. With the 1702A, the Address is first set in complementary then converted to the true address before the program pulse is applied.

Pin configurations for the 1702A and 2708 are given on the next page.

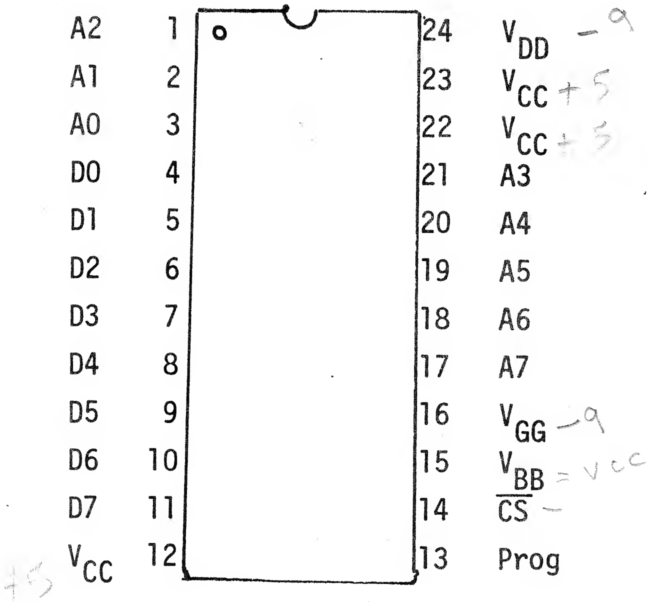
### IMPORTANT

We have noted varied operations from EPROMs. Some of the typical effects associated with the EPROM are:

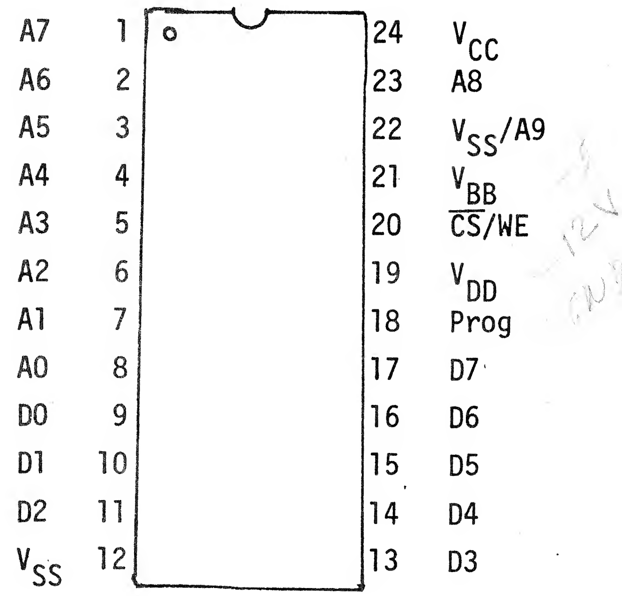
1. Light sensitivity
2. Inability to erase some bits
3. Inability to write some bits
4. Phantom bits
5. Inability to write given decoder lines.

Also, the EPROM can be destroyed by static electricity.

1702A




2708




3.2 MAIN MODULE BOARD

A simplified block diagram of The Prom Setter is shown in Figure 6.

The Data bus is supplied in parallel to the Address, Data, and control latches. The Address latch sets 10 lines, of which 8 lines can be pulsed for operating with the 1702A EPROM. The Data latch sets 8 lines which can also be pulsed for 1702A operation. The control latch produces 7 control lines, of which 4 lines are pulsed.

The full schematic for the main module board is shown in Figure 31. A detailed explanation of the circuit operations is given below.

The main module board sets the data, address, and control voltages.

The computer communicates with the main module board, which operates as a four (4) consecutive address Input/Output device. This consecutive address is selected with the first two bits AØ and A1 of the I/O address set by the computer. A listing of the action in the main module controlled by I/O address bits AØ and A1 is given in Table 1.

The rest of the addresses, A2 through A7, are selected by the user. This selection is made by connecting to ground the appropriate pull-up resistors R8A through R8F.

There must be at least one position grounded in the address select. Otherwise, a conflict will occur between The Prom Setter and the machine at address "FF".

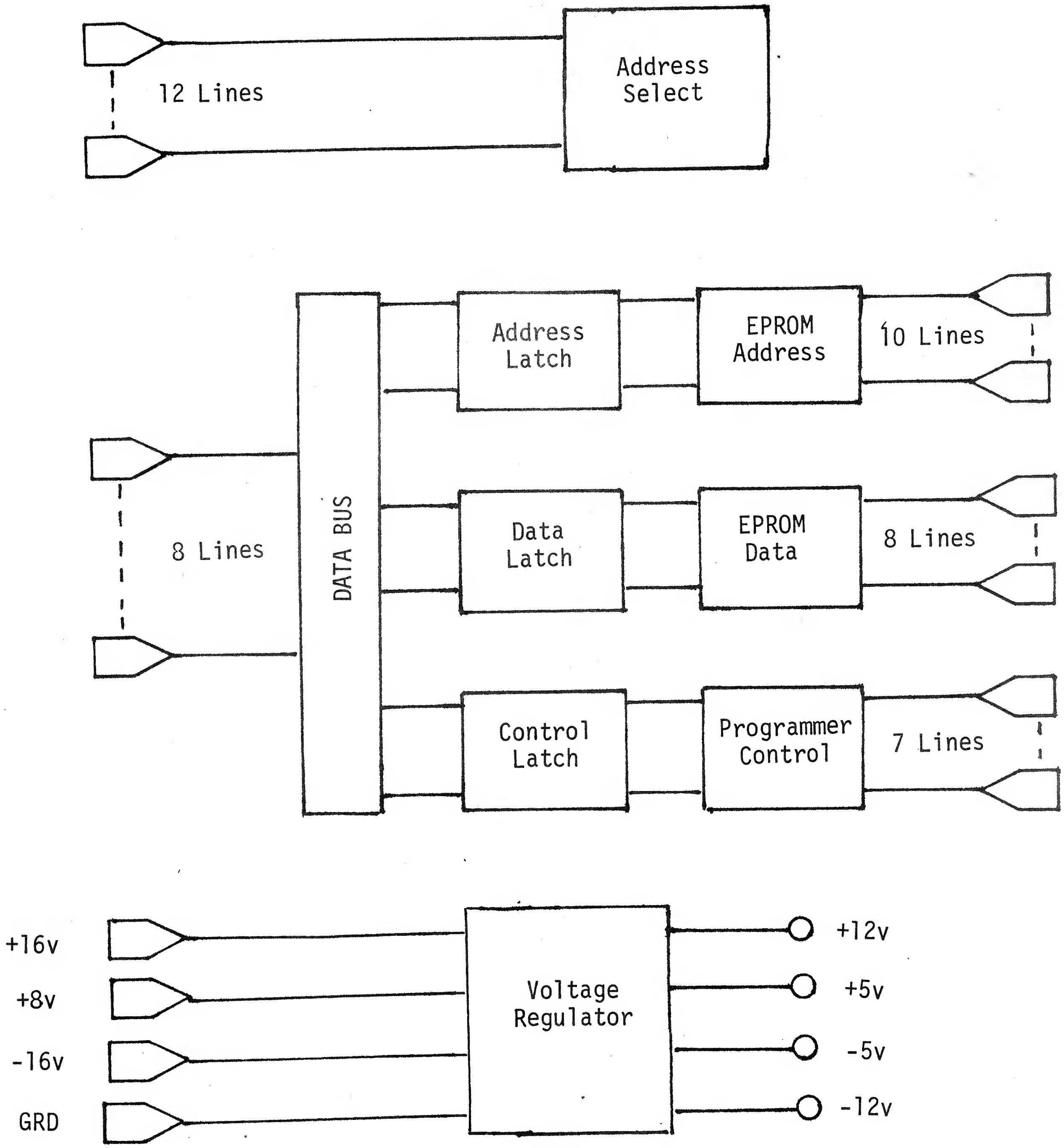



Figure 6. The Prom Setter Simplified Block Diagram

Table 1. I/O Address Bits AØ and A1, Main Module Operation

| Address Select | A1 | AØ | Data* Control | Operation |
|---|---|---|---|---|
| Ø | Ø | Ø | 1 | Set Control |
| 1 | Ø | 1 | | Set lower Address |
| 2 | 1 | Ø | | Set upper Address |
| 3 | 1 | 1 | | Set Data |
| 1 | Ø | 1 | 2 | Read Status Test |
| 3 | 1 | 1 | | Read Data |

*See Appendix III, 74155 Decoder.

The programming controls are used to set the circuit conditioning voltage for the EPROM.

The conditioning circuit can be disabled by two conditions. These are operation of

1. The Write Disable switch
2. Excessive circuit current.

The Write Disable switch is located on the PROM socket board and is used to prevent accidental operation of the pulse generation circuits used to write the PROMs. When writing the PROMs, this switch must be in the OFF position.

The excessive circuit current control is used to protect The Prom Setter components. There are three excessive current sensing circuits. These are Q20, Q21, and Q22, with resistors R33A/B, R34A/B, and R35A/B. When excessive current exists, then the voltage drop across the base to emitter resistors will increase until the transistor collector will start drawing current through (latch U12 resistor) R43. When the voltage at pin 10 of U12 becomes "0", the latch will switch, turning off the pulse generator voltages.

The excessive current may be a result of a bad EPROM that has an internal short or accidental shorting of the pins of the EPROM socket.

The status of the Write Disable switch and excessive current latch U12 can be read by setting Input Address A0 and A1 to "1", as given in Table 1 above.

The programming controls are set by the output port's first four bits—DØ, D1, D2, D3—when Address AØ and A1 are "0". A listing of the control word operation is given in Table 2.

Table 2. Control Word Operation

| Output Port Word | | | | Operation |
|---|---|---|---|---|
| D3 | D2 | D1 | DØ | |
| 1 | X | X | X | Reset Latch |
| 1 | Ø | Ø | Ø | Read |
| Ø | Ø | Ø | Ø | Set Puse Generator Charge |
| Ø | 1 | Ø | Ø | Pulse Generator ON/2708 Program ON |
| Ø | 1 | 1 | Ø | Pulse $V_{DD}/V_{GG}$ ON |
| Ø | 1 | 1 | 1 | Pulse 1702A Program ON |

There are two pulse generators used to produce the programming voltages of +26 volts for the 2704/2708 and a -47 volts used to program the 1702A's.

These pulse generator operations are similar, although they produce pulse voltages of opposite polarity. The pulse capacitors are charged when pin 11 of U11 is a "1" and pulsed when pin 10 of U11 is made a "1".

The positive pulse capacitor C7 is charged from ground through the forward diode conductance of CR9 to -16 volts through R16 and transistor Q9. This places -16 volts across the capacitor referenced from ground. Output voltage is produced by turning off the charge circuit and turning on the pulse transistor Q6, which brings the bottom of the capacitor to +16 volts. This would raise the top end of C7 to about 32 volts, except for the zener operation of CR9 which holds this voltage to +27 volts. Resistor R9 limits the current and protects the zener diode from excessive currents.

The negative pulse capacitor C~~8~~9 is charged from -16 volts through the forward diode conductance of CR24 to +16 volts through R40 and transistor Q24. This places a total of about 32 volts across the capacitor. Output voltage is produced by turning off the charge circuit and turning on the pulse transistor Q27 which brings the top of the capacitor to a -16 volts. This would raise the bottom end of C~~8~~9 to about -48 volts.

Feedback zener diode CR25 limits the output to -47 volts.

The 1702A Address, Data and programming circuits are similar. The following description applies to all of these circuits.

When the negative pulse is present and the input 680-ohm resistor sees a "1", then the input PNP transistor is made to conduct, causing its collector to pull current through the output NPN transistor base. This turns the output transistor ON and its collector is pulled down to its emitter. Under normal conditions, the voltage of collector to emitter on the output transistors is only a fraction of 1 volt.

When the negative pulse is not present, the output transistor emitter is at about -16 volts. Now turning on the input PNP transistor will result in almost no current flowing in its collector since the zener, a 27-volt device, placed between this point and the output transistor base cannot conduct enough current to turn the output transistor ON.

The 1702A $V_{DD}$ and $V_{GG}$ pulse circuit operation is similar to the above description except for the diode and zener arrangement which holds these outputs to about -9 volts when not being pulsed and produces a 10-volt lower pulse for $V_{GG}$ when pulsed.

Read/Write voltages for both the 1702A and 2704/2708 are produced with transistors Q16, Q17, Q18, and Q19. These circuits are switched when going from or to Read/Write.

In Write, Q17 is ON and Q19 is OFF. In Read, the reverse happens, where Q17 is OFF and Q19 is set ON.

### 3.2.1 Latch Operation

There are six 4-bit latches used on the main module. These are U9, U13, U14, U15, U16, and U17.

Latch U9 is used to hold the output control word.

Latch U13 holds the upper address word, while U14 and U15 hold the lower address word.

Latches U16 and U17 hold the 8-bit data programming word.

The data word from the S-100 bus passes through isolation IC's U5 and U6 and is paralleled to all of the latches. When an appropriate output address is selected, an enable pulse from multiplex U2 enables the particular latch to reflect in input data bus signals. This enable pulse width is controlled by the S-100 bus signal $\overline{PWR}$ and must be turned OFF before the data bus signals are changed. Otherwise, the latch would reflect the changed data word and not the desired word.

If the input Data word has been loaded by other computer cards, there may be incorrect operation of the latch.

3.2.2 Address Select for I/O Operation

The Address Select U4 is a six exclusive OR circuit, which produces a "0" at pin 9 when the input address of bits A2 through A7 is the same as the selected address wiring.

This output (pin 9) will enable demultiplex U2 when it goes to "0". Demultiplex U2 is controlled by the lower two address bits AØ and A1, and by the input or output S-100 bus signals DB SNIP, DBN, and SOUT D3, along with $\overline{\text{PWR}}$.

3.2.3 Tri-State Logic

There are four tri-state IC's. These are U7, U8, U18 and U19.

Tri-state U7 and U8 are used for output signals to the S-100 bus.

The tri-state IC's output is in a high impedance state when the control line is a "1" and goes to a lower impedance state when the control line is a "0".

Tri-state U18 and U19 are used to drive the 2704/2708 Write operation. When U7 and U8 are in the low impedance state, U18 and U19 are in the high impedance state. This switches the Data latch output OFF when reading the EPROM input Data.

3.2.4 I/O Operation

The main module board can be used as an eight (8) bit parallel I/O port. The Address section is used as the output, while the Data section is used as the input. Operation is the same as when operating The Prom Setter.

The Data input signals are sent to connector J2 pins F, H, J, 12, K, L, M, and 11 for DØ, 1, 2, 3, 4, 5, 6, and 7. Connection can be made to the DB25S, J5 pins 4, 3, 2, 14, 15, 16, 17, and 18.

Output signals are obtained from J2 pins 23, 22, 21, 20, 19, 18, 17, and 16 for DO-Ø, 1, 2, 3, 4, 5, 6, and 7. Connection can be made to the DB25S, J5 pins 5, 6, 8, 9, 10, 11, 12, and 13.

Signals giving status of this input/output can be obtained by the upper address obtained from J2 pins 24 and 25, which can be found at DB25S, J5 pins 24 and 23.

3.2.5 Programming Timing

The programming timing for 1702A is shown in Figure 7. The Address and Data outputs are pulsed when the control pulse is produced.

To program a "1", the Data line must be pulsed (-48 volts) and a "0" produced by not producing any pulse and leaving the line near Ground.

The Address line is set to a "1" by not producing any pulse and set to a "0" by applying a pulse (-48 volts).

The programming timing for 2704/2708 is shown in Figure 8. The Address and Data outputs are NOT pulsed. The Address and Data lines are TTL programmed.

Different computers have different timing. The supplied program is set for a computer whose clock speed is about 500 nanoseconds. If the effective clock speed (actual computer clock speed or memory board wait cycle which reduces the speed) is either slower or faster, then the delay subroutine loop counts must be changed to achieve the waveforms as shown in Figures 7 and 8.

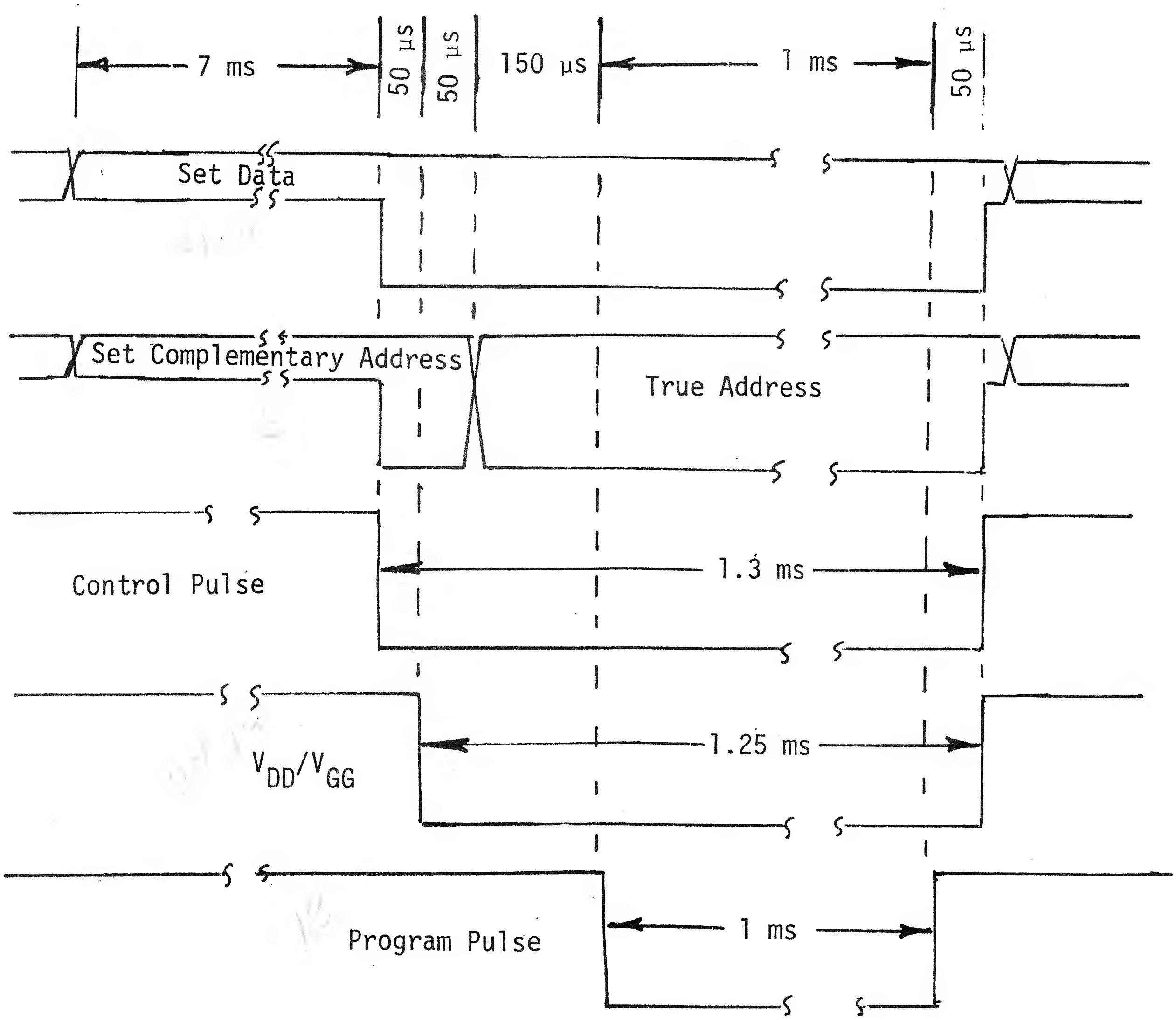



Figure 7. 1702A Timing Diagram

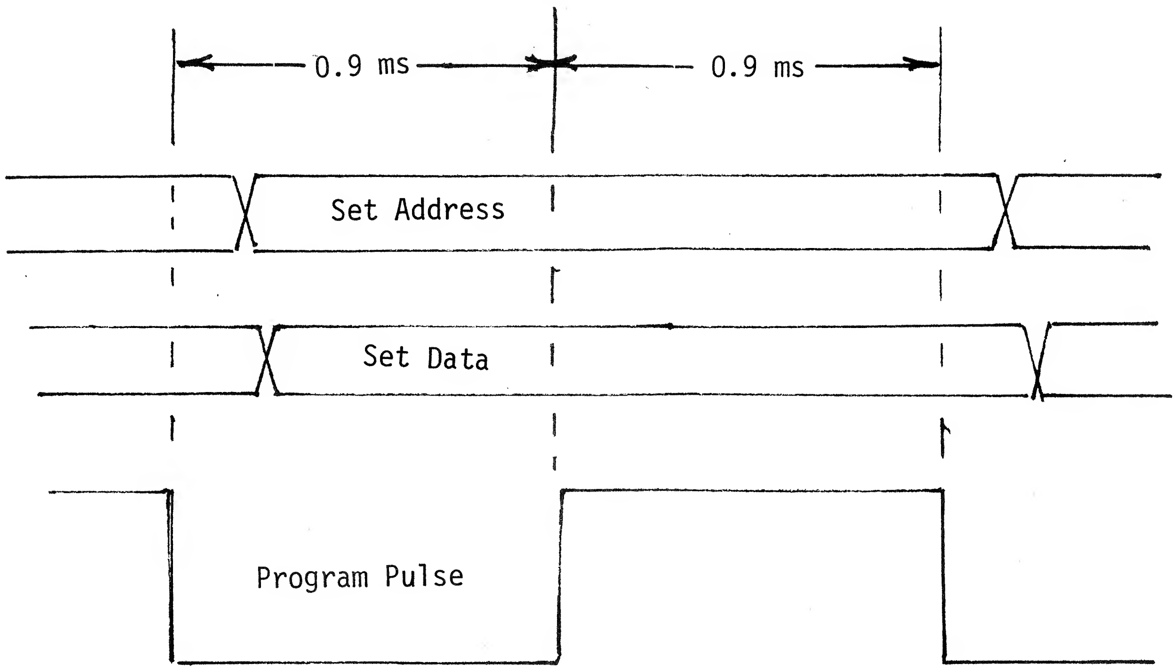



Figure 8. 2704/2708 Timing Diagram

## 3.3 PROM SETTER OPERATION

Selection of the EPROM type to be programmed for either Read or Write is accomplished by connecting the Prom socket board cable into the appropriate DB25 socket.

It is suggested that you always place the WRITE DISABLE switch ON when inserting or removing the EPROM.

We have found that the EPROM can be placed into or removed from the EPROM socket while the cable is connected to the computer. Also, good operation was obtained when leaving the EPROM in the socket and connecting or disconnecting the socket board cable from the computer.

CAUTION

Inserting the EPROM incorrectly into the wrong pins of the socket board could cause failure of the EPROM. Typical errors are placing the EPROM one pin in either direction out of alignment or completely turning the device around so that pin 13 is placed into pin 1 of the socket.

The following is the procedure for programming of EPROMs. It is assumed The Prom Setter is operating properly and that the program exists in the computer.

### 3.3.1 Reading an EPROM

STEP 1. Connect the socket board cable to the appropriate DB25 socket.

STEP 2. Toggle the Address length, the EPROM start Address, and the memory start Address into the computer. Then set the computer to the address for the Read program.

STEP 3. With the WRITE DISABLE switch ON, place the EPROM to be read into the socket on the socket board, and run the computer.

### 3.3.2 Writing an EPROM

The information to be written on the EPROM should reside in the computer before starting the next series of steps. See paragraph 5.2.3 for error indication during programming.

STEP 1. Connect the socket board cable to the appropriate DB25 socket.

STEP 2. Toggle the Address length, the EPROM start Address, and the memory start Address into the computer. Then set the computer to the address for the Write program for the type of EPROM being written.

STEP 3. With the WRITE DISABLE switch ON, place the EPROM to be written into the socket on the socket board. Then turn the WRITE DISABLE switch OFF and run the computer.

### 3.3.3 Testing Written EPROM

If this test takes place directly after writing of EPROMs, then the existing toggled information is already in the computer and it is not necessary to repeat Step 2. The information to be tested should reside in the computer. See paragraph 5.2.3 for error indication during programming.

STEP 1. Connect the socket board cable to the appropriate DB25 socket.

STEP 2. Toggle the Address length, the EPROM start Address, and the memory start Address into the computer. Then set the computer to the test program.

STEP 3. With the WRITE DISABLE switch ON, place the EPROM to be tested into the socket on the socket board and run the computer.

### 3.3.4 Test Cleared EPROM

See paragraph 5.2.3 for error indication during programming.

STEP 1. Connect the socket board cable to the appropriate DB25 socket.

STEP 2. Set the computer to the address for Test Program for the type of EPROM being tested and run the computer.

### 3.3.5 Error Indications

3.3.5.1 During the Write program (5.2.1), there are tests to establish improper operation. If there is improper operation, a printout is generated.

If the WRITE DISABLE switch is left in the ON position, a printout of the number "3" will result. It is necessary to turn this switch OFF and reset the start of the Write program.

If overcurrent exists, then a printout of the number "0" is produced. Try to rerun the program. If the condition still exists for the particular EPROM, then this device requires more current than The Prom Setter can supply.

3.3.5.2 During the testing of the EPROM (5.2.3), errors of incorrect EPROM words will produce a printout of the particular word address. The program will then continue finding all other errors. If errors are indicated, note what word should be at the error address, then read the EPROM (using 3.3.1 above) and check the word at the address.

If the error results during a Clear check, showing that the EPROM was not completely cleared, then try additional UV exposure. The UV exposure time must be longer than is necessary to just clear the device. Too short a UV exposure will result in phantom bits appearing in a word.

If the error results during a Written check, showing that not all the EPROM word bits were written, then try to rewrite the device. If the bit still is not written, where most of the other words are correct, it can be assumed that the particular EPROM is defective.

# SECTION IV

# TROUBLESHOOTING

4.0 Before troubleshooting, check the main module board for wrong or incorrectly positioned components. Look for excessive heat from a component. Doublecheck the soldering on the board.

You should have had experience in troubleshooting previously. If not, try to get a friend who has had this type of experience.

Remove and replace any defective components and return them for replacement under the Warranty provisions.

If solutions are not found for the problems, then follow the procedure listed in Section 1.3.3 for factory service.

## 4.1 GENERAL INFORMATION

A series of tests for The Prom Setter were outlined in Section II. There are four test steps which would insure proper operation of The Prom Setter. These are:

| | |
|---|---|
| Power supply voltages | Step 6 |
| IC operation | Step 13 |
| Zener CR3 | Step 16 |
| Pulse generation | Step 17 |

Improper operation during any of the above steps must be corrected before proper operation of The Prom Setter is obtained.

## 4.2 POWER SUPPLY VOLTAGE

Lack of voltage or low voltage can be caused due to a bad IC regulator, a short, or improper supply voltage to the main module.

First test the supply voltage from the computer main bus. This can be accomplished directly on the board at capacitors C1, C3 and C5. If low voltages are noted, move the voltmeter to the computer supply. If there is higher voltage at the supply, then there is a problem in your computer bus.

If the voltage at the supply and the module are about the same, then remove The Prom Setter module board and note if the computer supply voltage increases. If there is no change in the supply voltage, the problem is in the computer. Now, if the computer supply voltage increases to normal, then The Prom Setter board is drawing too much current for the computer supply.

If this indication of low voltage occurred after components were placed on the board, other than the IC sockets, go to the second paragraph below. If it was measured before putting the active components on the board, continue with the next paragraph.

It is necessary to establish if there is a short on The Prom Setter board. This can be accomplished by lifting the output lead of the voltage regulator from the board and connecting a current meter between the lead and the main circuit. Start at the highest current range and work your way to lower ranges, but not below the 1-amp range. If the current is 1 amp or higher, then there is a short on the board. Carefully inspect the board for any solder splashes and excessive solder around connections. Correct any abnormal conditions.

The following paragraphs deal with shorts existing only after the active components are placed on the board. It is assumed that all components are in their correct position and are properly oriented as to pin connection. Under these conditions, it has to be assumed that one of the transistors or IC's is internally shorted.

If the short is on the 5-volt line, then the problem is most likely due to a short internal to one of the IC's. Remove the IC's one at a time while observing the current meter until the excessive current is reduced to a normal level. The normal current with all IC's on the board for the 5-volt lines is less than 0.7 amps.

Upon removing all IC's, if there are still excessive currents, look for shorts due to solder splashes or excessive solder.

If the short is on the plus or minus 12 volt lines, the problem is most likely associated with solder shorting one of these lines to ground. Double check the soldering in this area.

If the short is on the plus or minus 16 volt lines, the problem is most likely associated with the pulse generation circuit. Check R9, R16, and R40 for overheating. If these show no problem, then check all of the 2N2222A on the address, data and program circuits for overheating.

If all of the above resistors show signs of being overheated, then remove IC U11. If the voltage returns to normal level, check IC U11 for improper operation.

If R16 or R40, but not both, shows signs of overheating, look for shorts on the board. If none are found, then remove the resistor in question and test the circuit for a transistor that has an internal short.

## 4.3 IC OPERATION

Lack of proper signals from an IC can be caused by a bad device. If the problem exists on an IC that is used in other places on the board, then exchange the two IC's and see if the problem stays or moves with the exchanged device.

If the problem stayed, even though the IC's were changed, then inspect the board for poor solder joints or excessive soldering which has shorted the pin to adjacent pins or printed circuit lines.

Test signal lines for shorts by removing the IC's associated with the circuit and connecting a voltmeter to the particular signal pin. Except for the address select, there are no pull-up resistors. The pin should read "no voltage". If a voltage is read, then check for shorted lines. If no voltage is read, then using a resistor of about 1k ohms connect one end to the +5 volt line and the other end of the resistor to the pin being checked. The voltage should go to +5 volts. With the resistor still connected to the pin, check pins on either side (other than those that are wired together) for voltage. Remove the resistor and, if the voltage on adjacent pins is also removed, then there is most likely a short between the pins. If an unwanted short is shown to exist, then remove the excessive solder and retest.

Another problem can result from the IC pins being bent under the case. It is difficult to see a bent pin while the IC is in the socket. Remove the IC and look for bent pins.

If problems of latch operations are noted, check the signal $\overline{\text{PWP}}$ from pin 77 on the S-100 bus. This is a narrow pulse which comes on when the data is stable and must go OFF before the Data bus is changed.

Excessive loading of the Data bus lines due to other devices plugged into the S-100 bus could cause improper operation. Remove these devices and test for latch operation. If proper operation is obtained, then some modification to the S-100 drive for the Data bus lines or reduction of the device which loaded these lines should be considered.

## 4.4 ZENER CR3

If a negative 12 volts is measured, then either the zener is in backwards or the zener is shorted. Replace or place the zener in the proper direction.

## 4.5 PULSE GENERATOR OPERATION

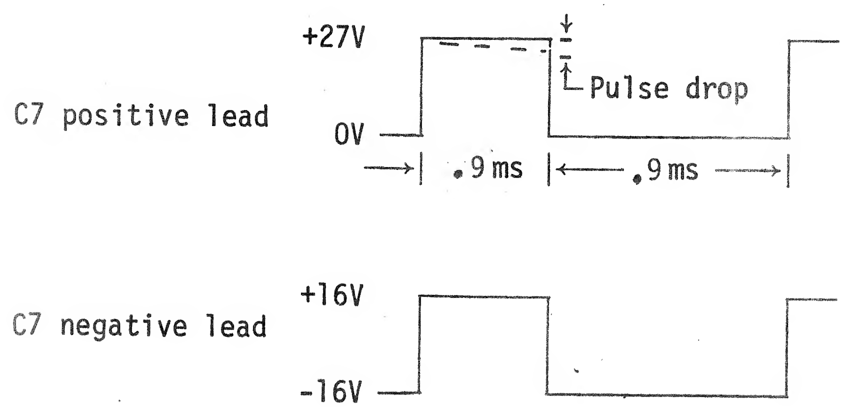
There are two pulse generators used in The Prom Setter, one for generation of a +27 volt pulse and the other to generate a -47 volt pulse. It is advisable to use an oscilloscope during troubleshooting of these circuits.

At no time should R9, R16 or R40 become excessively warm. If that condition does exist, it indicates that both the charge and the pulse transistors are conducting at the same time. The circuit is arranged such that these two transistors cannot be on (except during switching transients) at the same time.

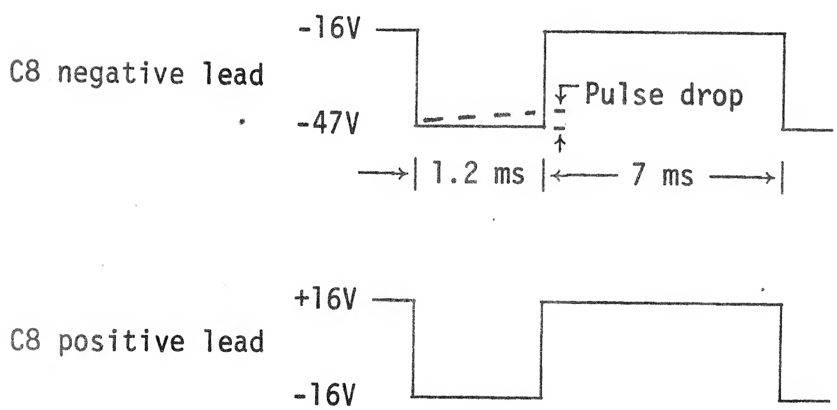
If R16 or R40 shows signs of excessive heating, then a problem exists in the pulse and charge circuits.

Normal waveforms for the pulse generators are given below, when in the 1702A Write program. With low ±16 volt lines, the pulse peak voltage will reduce. When these lines are a low ±14 volts, then programming of 1702A will require about 10 minutes.

Positive Pulse Generator Waveform




Negative Pulse Generator Waveform




## 4.6 PROBLEM WITH WRITING EPROM

There are a number of problems that may cause improper writing of the EPROM. Some improper operations of EPROM are listed in Section 3.1.

If partial writing of an EPROM takes place, where some cleared bits have not been written, then try rerunning the program.

To troubleshoot, place an oscilloscope on the output from the pulse generator (the positive lead of C7 for the positive pulse, the negative lead of C~~8~~9 for the negative pulse). Run the Write program without an EPROM in the socket board. Note the waveform at the pulse ON

time. (See the waveforms above.) Now place the EPROM in the socket board and repeat the Write program. Note the voltage of the pulse at the end of its ON time. The pulse drop in about 1 ms without the EPROM should be less than 2 volts, and should be less than 7 volts with the EPROM in the socket.

If greater pulse displacement takes place with the EPROM in the socket, there will be problems in writing. Typically, earlier 1702's tested exhibited higher currents and programming was not possible.

# SECTION V

# SOFTWARE

THE PROM SETTER SECTION V

## 5.1 GENERAL INFORMATION

The software supplied will perform all the functions to Write or Read EPROMs. The main programs are given below. These are:

| | | |
|---|---|---|
| 1. | Write 1702A (ØØØØ) | Figure 9 |
| 2. | Write 2704/2708 (ØØ4~~5~~)6 | Figure 10 |
| 3. | Read 1702A and 2704/2708 (Ø1AØ) | Figure 11 |
| 4. | Test Clear 1702A (ØØ84) | Figure 12 |
| 5. | Test Clear 2704/2708 (ØØAA) | Figure 14 |
| 6. | Test Written EPROM 1702A and 2704/2708 (ØØ7Ø) | Figure 15 |

A series of subroutines are required to perform with the main programs. These are:

WRITE

| | | |
|---|---|---|
| 1. | Initialization (ØØC3) | Figure 16 |
| 2. | Parameter Set (ØØCE) | Figure 17 |
| 3. | Set Data Set and Test Conditions (Ø12C) | Figure 20 |
| 4. | Delay (ØØDC) | Figure 18 |
| 5. | Test END (Ø1Ø8) | Figure 19 |
| 6. | Address (Ø1ØØ) | Figure 13 |

READ

| | | |
|---|---|---|
| 1. | Read 1 (Ø142) | Figure 21 |
| 2. | Read 2 (Ø14F) | Figure 21 |

Further Subroutines

| | | |
|---|---|---|
| 1. | Hex Print (Ø161) | Figure 22 |
| 2. | Hex 1 Print (Ø175) | Figure 23 |
| 3. | Hex 2 Print (Ø186) | Figure 24 |
| 4. | Print Word (Ø1BØ) | Figure 25 |
| 5. | Print (Ø~~1A3~~) 195 | Figure 26 |

The printout words are located at Ø1CØ.

It is necessary to toggle into the computer information about locations and lengths for the EPROM and Memory before the program can be run. This data is read by the Parameter Set subroutine during operation of the program. The following is the address where this information is toggled in. To operate, set the computer to the RAM address given and toggle in the information.

for 1702

| ADDRESS A | B | C | D | Computer Address (Hex) | | Description (to be Toggled IN) | |
|---|---|---|---|---|---|---|---|
| | | | | 01F8 | FF | Lower Length | Size of program to be read or written |
| | | | | 01F9 | 03 | Upper Length | |
| 00 | 00 | 00 | 00 | 01FA | | Lower Address | EPROM start address |
| 00 | 01 | 02 | 03 | 01FB | | Upper Address | |
| 00 | 00 | 00 | 00 | 01FC | | Lower Address | Memory start address |
| C0 | C1 | C2 | C3 | 01FD | | Upper Address | |

The Delay statements written in the program are for a 500 nsec clock period computer. The Delay subroutine is located at address ØØDC. When slower or faster clock rates are used, then it is necessary to change the loop counts which set the given delays.

The Delays are established by the words at the following locations:

| Delay | | Address |
|---|---|---|
| 50 | µs | ØØFA — 01 |
| 150 | µs | ØØF4 — 04 |
| 0.9 | ms | ØØEE — 2B with God [illegible] |
| 1 | ms | ØØE8 |
| 8 | ms | ØØDD and ØØDE |

The full program uses ~~461~~ 512 words. An allocation on top of this is required for toggled-in information and the Stack pointer operation.

## 5.2 FLOW DIAGRAMS

The following are the flow diagrams for the supplied programs.

### 5.2.1 Write 1702A

The 1702A Write flow diagram is shown in Figure 9.

The Stack pointer is set to a location selected by you. It is usually set near the top of the memory. During operation, program information is stored in descending address from the address of the Stack pointer.

The loop count sets the number of times one full EPROM address set has beem completely programmed. The loop count was set to a value that would properly write the EPROM. With the given loop count, full programming of the ~~265~~ 256 words takes 2-1/2 minutes.

The Initialization subroutine stores the loop count above the Stack pointer. It then resets the control latch and then sets the pulse generator to the Charge mode.

The next subroutine, Parameter Set, goes to a memory location where the EPROM address length, EPROM Start address, and memory Start address was toggled in before starting the run of the program. The location of these three double words are selectable to any part of the memory. We suggest that these words be placed above the Stack pointer and loop count address.

The Set Data and Test condition will set the Data latch of The Prom Setter and then test the condition of the control logic to see if the Write Disable switch was ON or if an overcurrent condition existed. If abnormal conditions exist, the computer will print out a number showing the condition as shown below:

| | | |
|---|---|---|
| Write Disable ON | = | 3 |
| Overcurrent | = | 0 |
| Both of the above | = | 2 |

The next group of steps is the algorithm used to program the EPROM, which sets the pulses ON and OFF with proper delays to program one address of this EPROM.

One full EPROM address is called a page. The next step of the program is to reduce the page count by one and then to test if the page has been completed. If the page is not complete, the program continues to the next higher address for both the memory and EPROM. If the page is complete, the loop count is reduced by one and tested to see if the loop count has been reduced to zero. If the loop count is not zero, then the program goes back to the preset parameters for length of the page and Start address, and repeats the above. Upon completing the loop count, the computer will print Completion of Write.

5.2.2 Write 2704/2708

The 2704/2708 Write flow diagram is shown in Figure 10.

The 2704/2708 program is similar to that for the 1702A, except that it uses a different algorithm for programming this EPROM.

5.2.3 Read Programs

The Read and Read Test are similar programs as can be seen by their flow diagrams. The center of the program changes to put the data read into memory, or to compare the data read to that held in the memory, or to compare the data read to zeroes or ones.

The program sets the Stack Pointer, then goes to Read 1. The program continues to store or test the data read. The program now goes to Read 2 and then loops until the words have been read.

During the test programs, any errors that are detected have their address locations printed out.

In the cases of Test Read, if an error is detected, the address is printed out in Hex form. The program then returns to test other locations till page end is reached.

5.2.3.1 Read 1702A and 2704/2708 flow diagram is given in Figure 11. The word Read from the EPROM is placed into memory.

5.2.3.2 Test Written EPROM 1702A and 2704/2708 flow diagram is given in Figure 12. The word Read from the EPROM is compared with the word in memory.

5.2.3.3 Test Clear 1702A flow diagram is given in Figure 14. Each word of the EPROM is tested for all bits to be zero.

5.2.3.4 Test Clear 2704/2708 flow diagram is given in Figure 15. Each word of the EPROM is tested for all bits to be "1".

5.2.4 Relocation of The Prom Setter Programs

To assist in relocation of the programs, an additional program is included. This program will allow the relocation address to be established by you. The revised program is located at Hex address Ø4ØØ to Ø6ØØ.

You set the Relocation address and the Stack Pointer address as given below. (Note that the Stack Pointer address must reside in RAM memory and requires six (6) words of RAM space above and below the given address.)

| | | |
|---|---|---|
| Relocation | { | Ø3FA<br>Ø3FB |
| Stack Pointer | { | Ø3FC<br>Ø3FD |
| I/O Address * | | Ø3FE |

This program is located at Address Hex Ø2ØØ. To run the program, set the Relocation and Stack Pointer address as given above. Then run the program.

The Prom Setter program located in the bottom address (i.e., from ØØØØ) is now shifted up to address starting at Ø4ØØ and all the statements have been corrected to reflect the selected relocation and stack pointer.

Note that the program now located at Ø4ØØ cannot be used at that address (unless that is where you wanted to relocate this program) since the jump statements have the address of the relocation which are outside of the present program location. You are now ready to copy this on an EPROM for use at the relocated address.

To write the EPROM, set the toggle information at 01F8 to 01FD, as shown top page 57.

* Note: TTY I/O must be corrected after relocation program run at Ø596 and Ø59E.

| | 1702A | | 2704/2708 |
|---|---|---|---|
| Address | 1st | 2nd | |
| 01F8 | FF | FF | FF |
| 01F9 | ØØ | ØØ | Ø1 |
| 01FA | ØØ | ØØ | ØØ |
| 01FD | ØØ | ØØ | ØØ |
| 01FC | ØØ | ØØ | ØØ |
| 01FD | Ø~~3~~4 | Ø~~4~~5 | Ø~~3~~4 |

It takes two 1702A to hold the full program. Only one-half of the 2708 EPROM storage is required for this program.

Once the toggle addresses are set, then go to the Write program for the given EPROM:

| | |
|---|---|
| 1702A Write | ØØØØ |
| 2708 Write | ØØ4~~A~~6 |

and run the program. At completion, test the writing by going to the Test program located at ØØ7~~Ø~~0.

# PROGRAMS

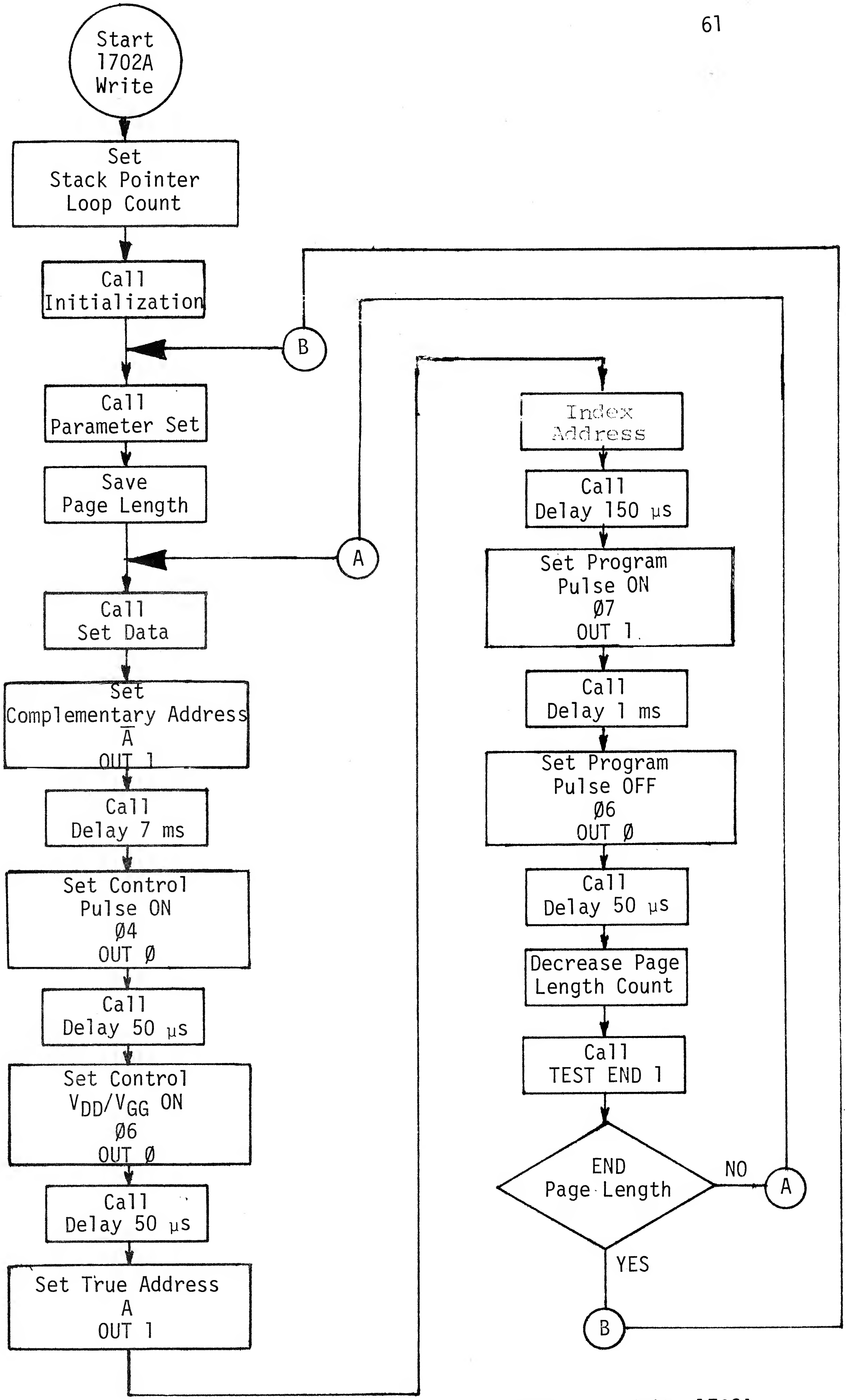



Figure 9. Write 1702A

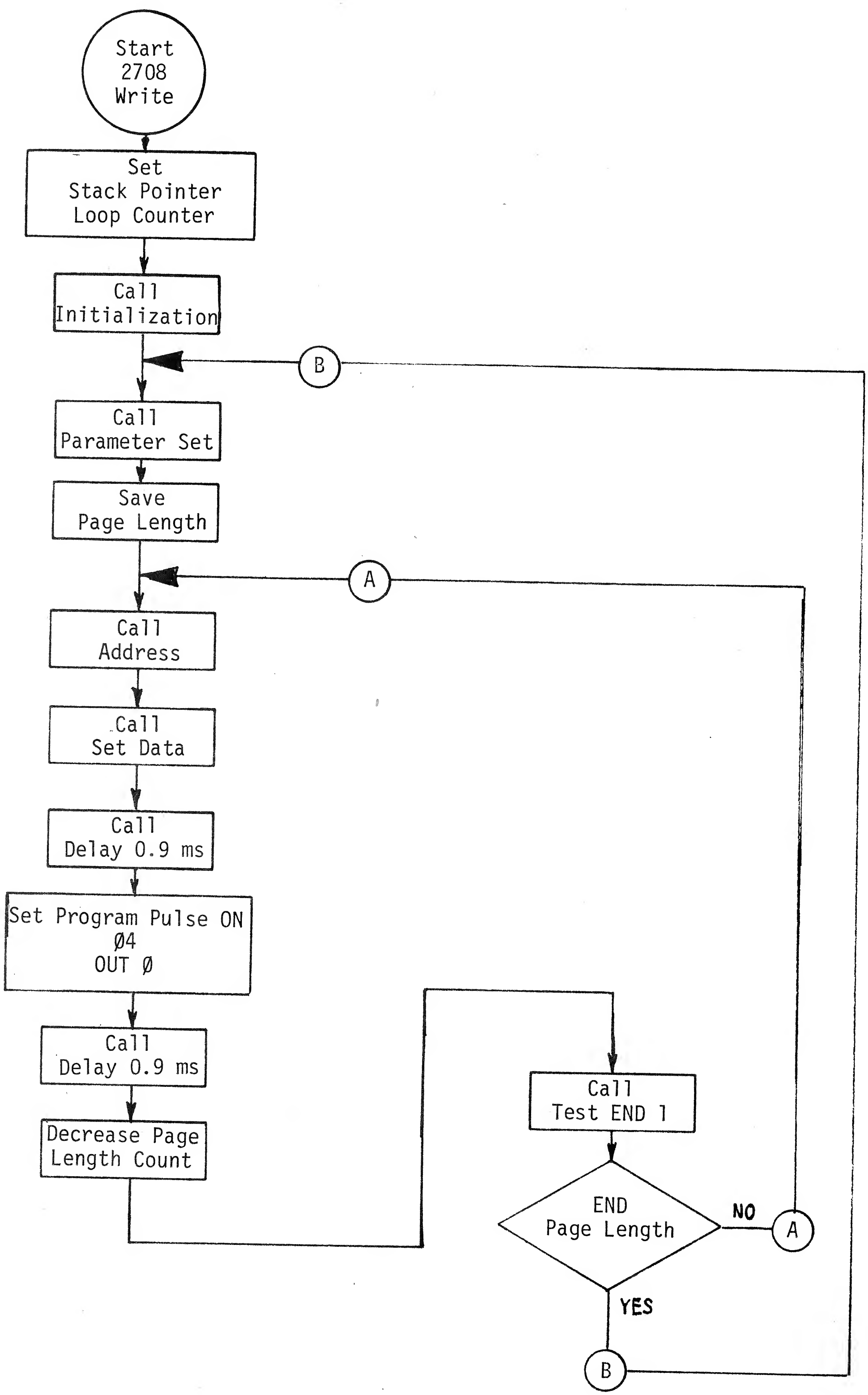



Figure 10. Write 2704/2708

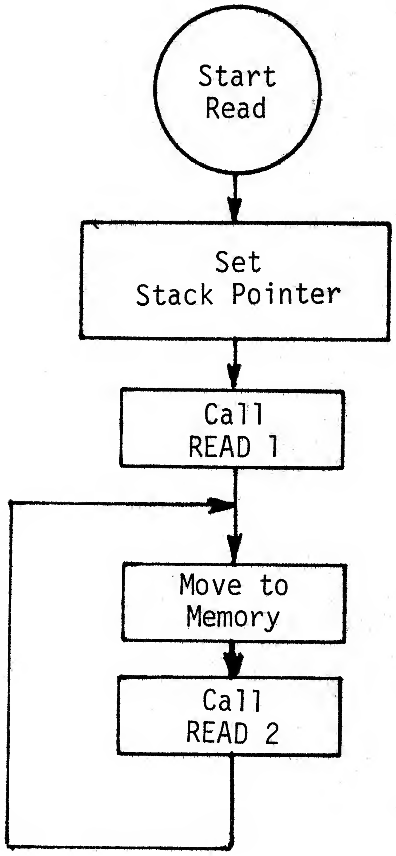



Figure 11. Read 1702A and 2704/2708

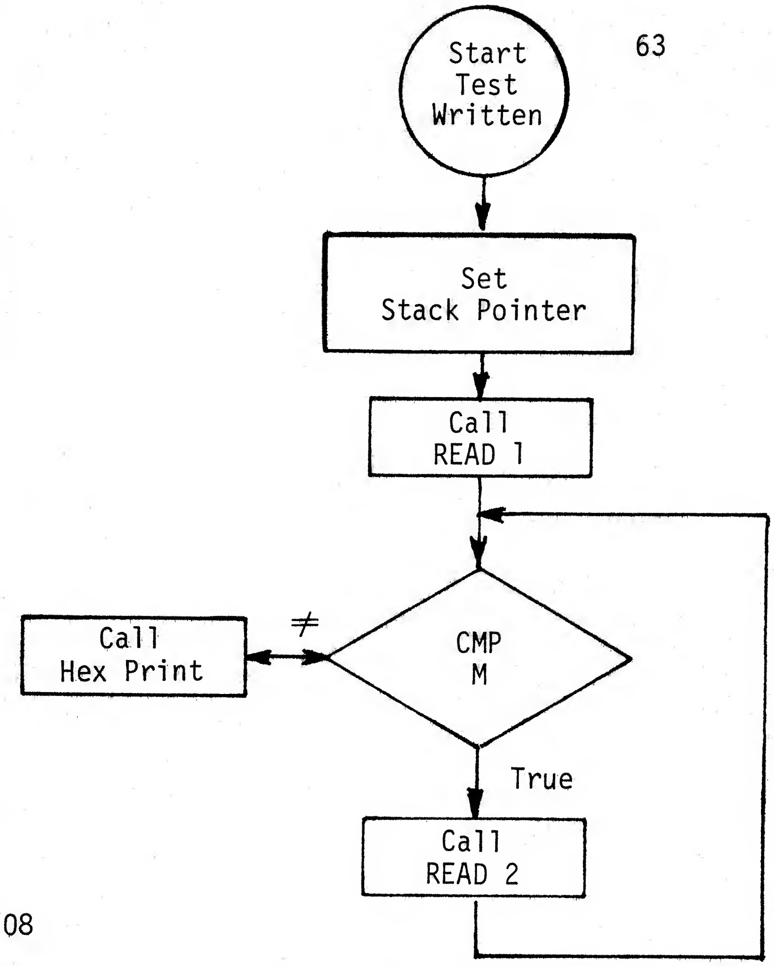



Figure 12. Test Written EPROM 1702A and 2704/2708

Figure 13. Subroutine Address Set

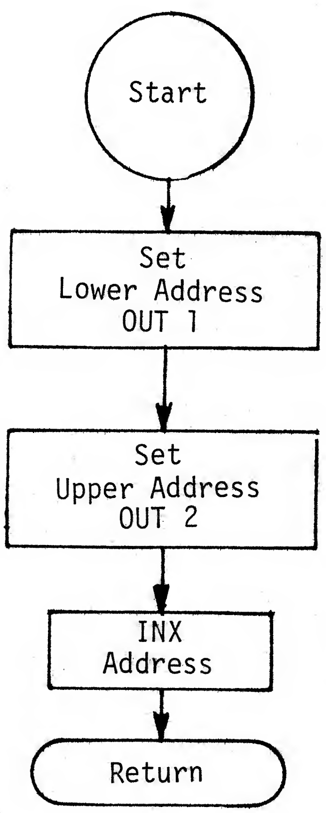



Figure 14. Test Clear 1702A

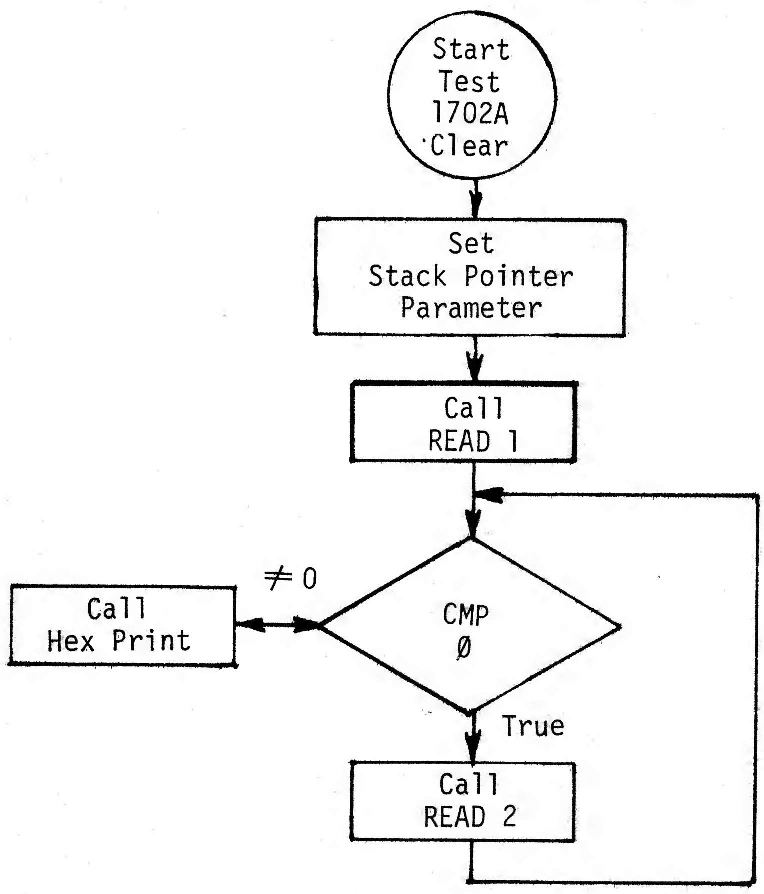


Figure 15. Test Clear 2704/2708

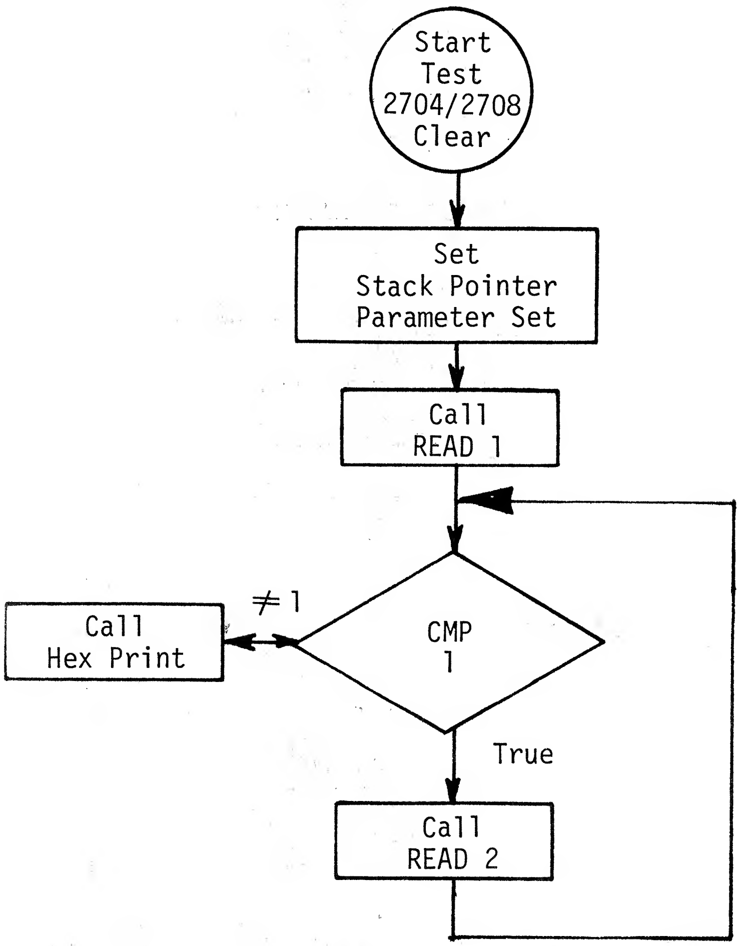
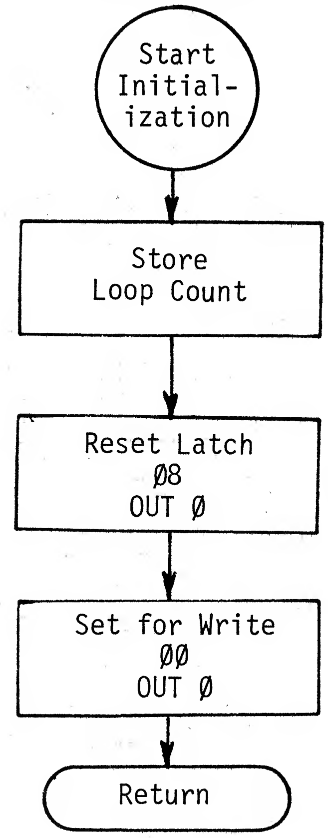



Figure 16. Initialization





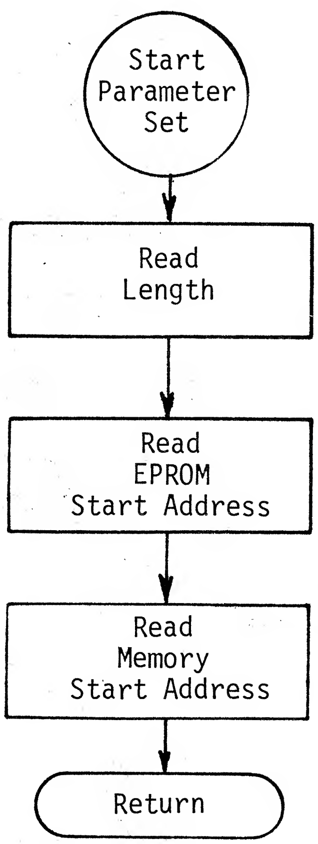




Figure 17. Parameter Set

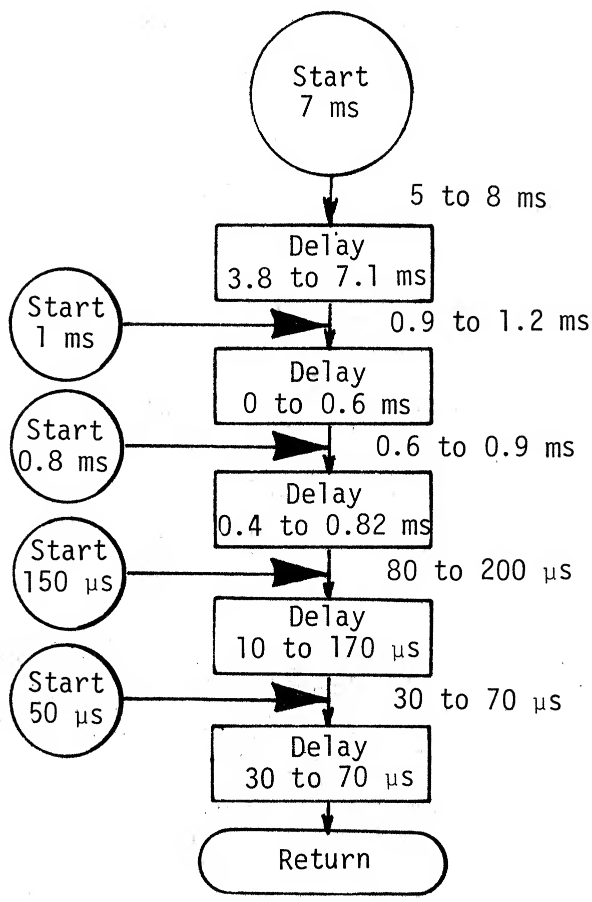



Figure 18. Subroutine Delay

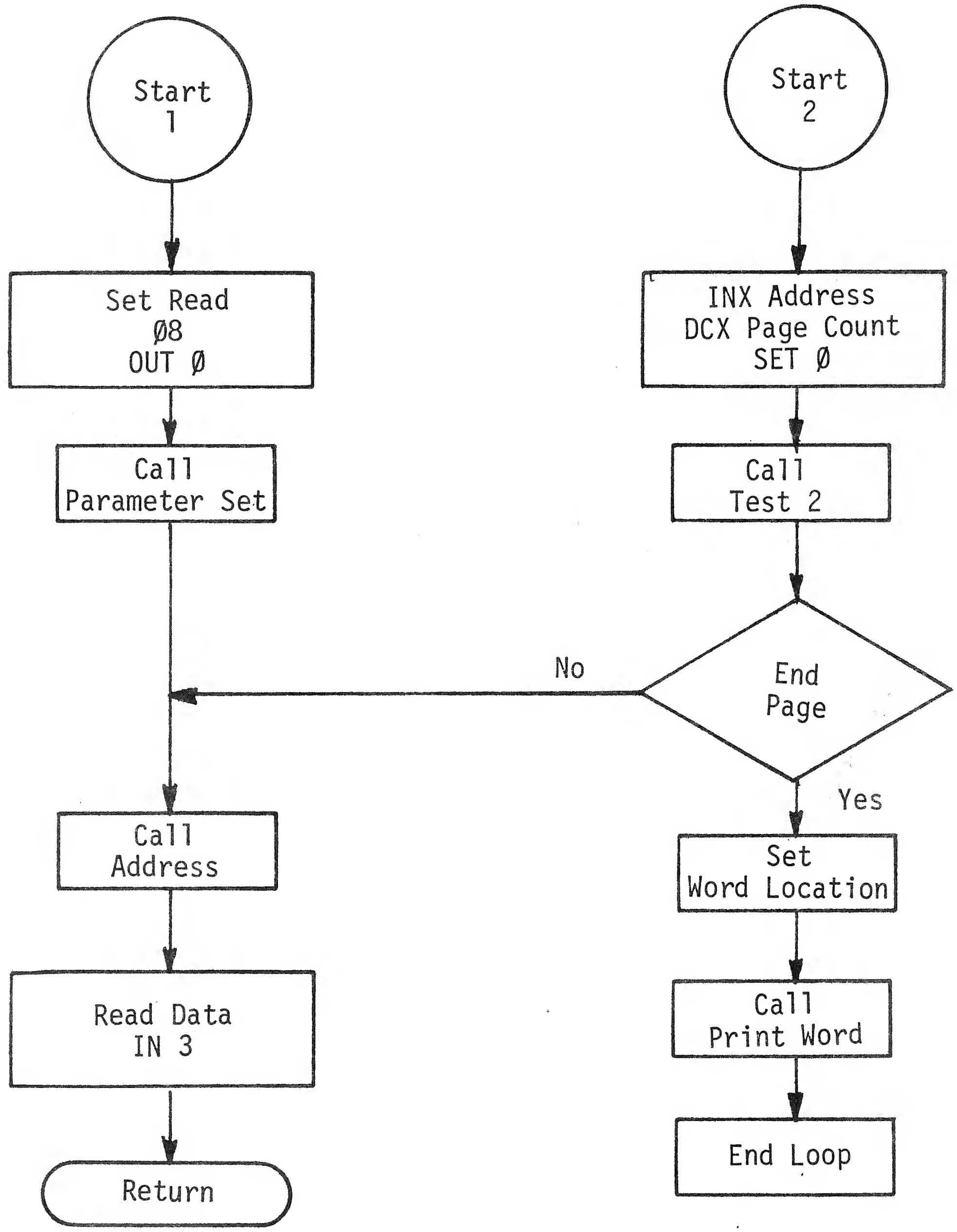



Figure 21. Subroutine Read 1 and 2

Figure 22. Subroutine HEX PRINT

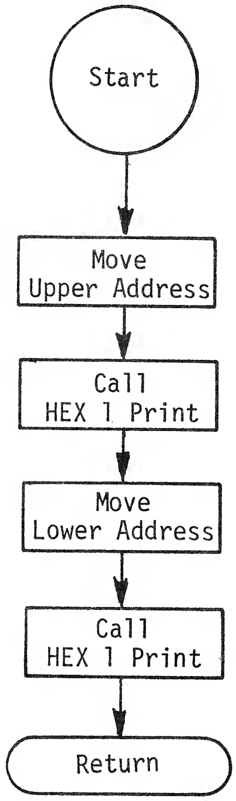



Figure 23. HEX 1 Print

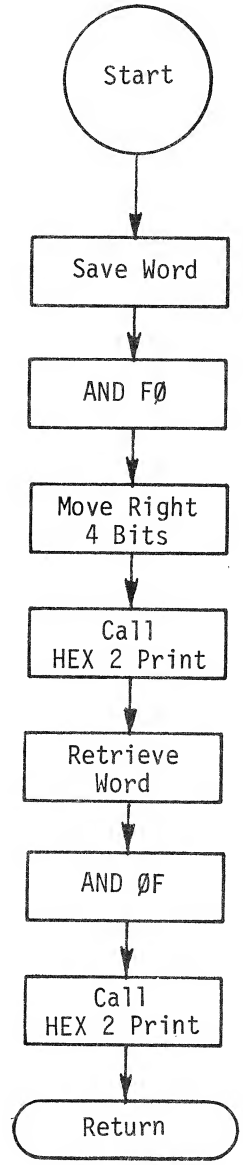
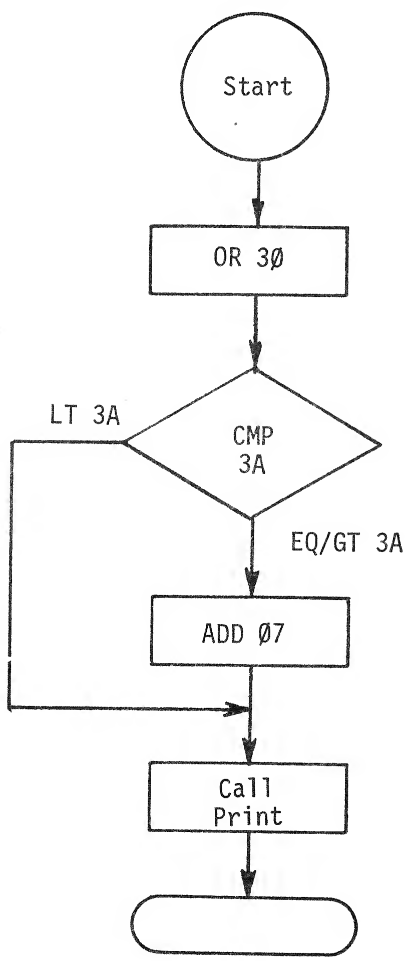



Figure 24. HEX 2 Print



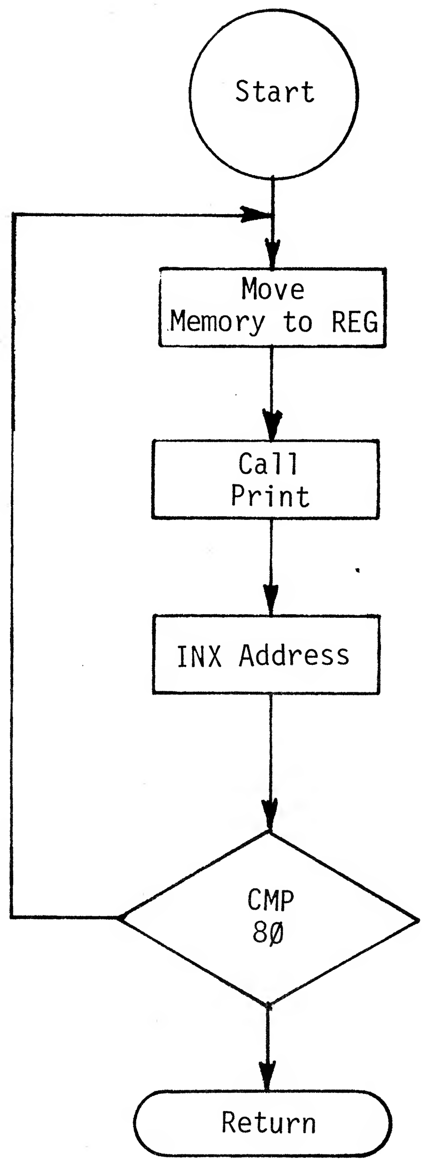



Figure 25. Subroutine PRINT Word

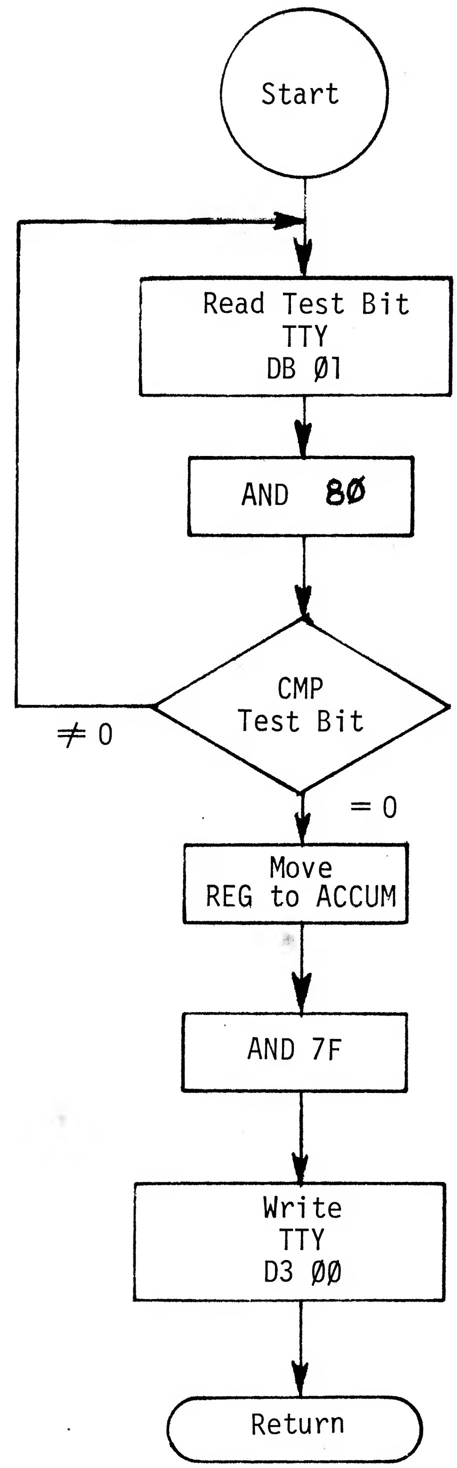



Figure 26. Subroutine PRINT

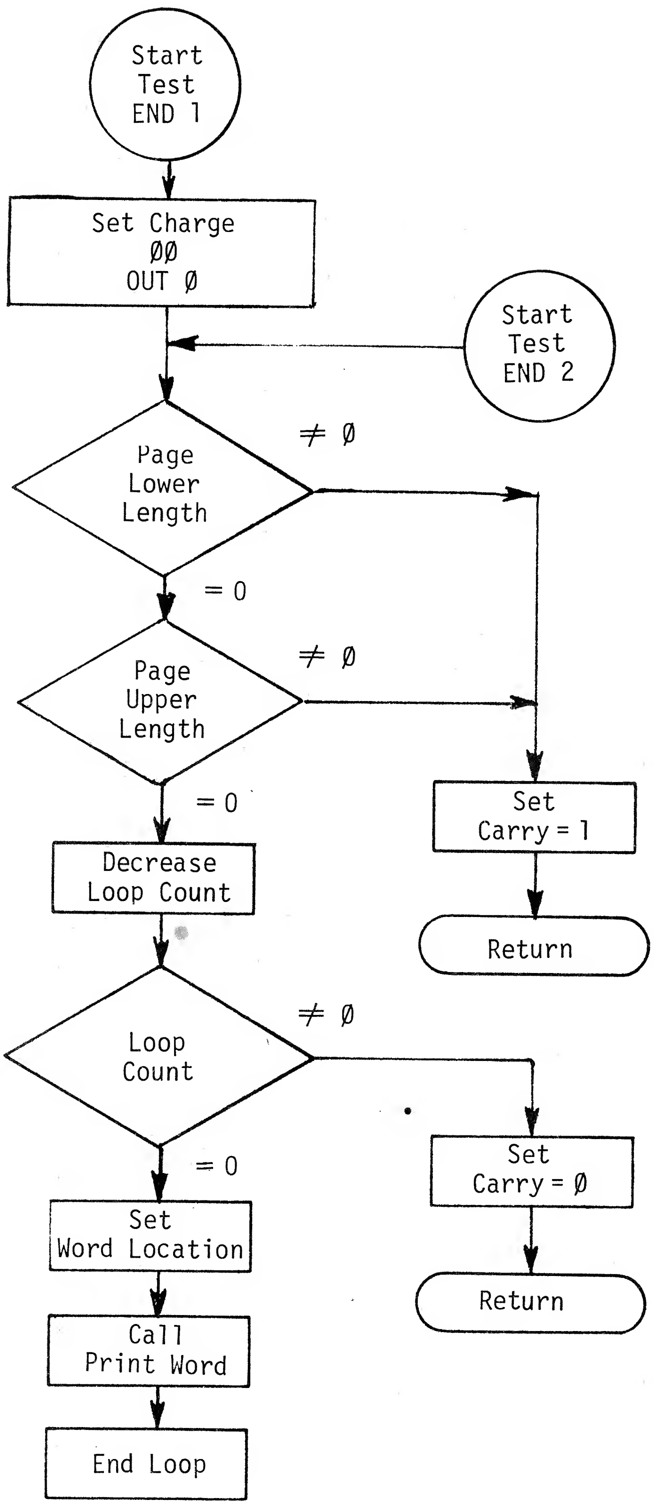



Figure 19. Subroutine Test End

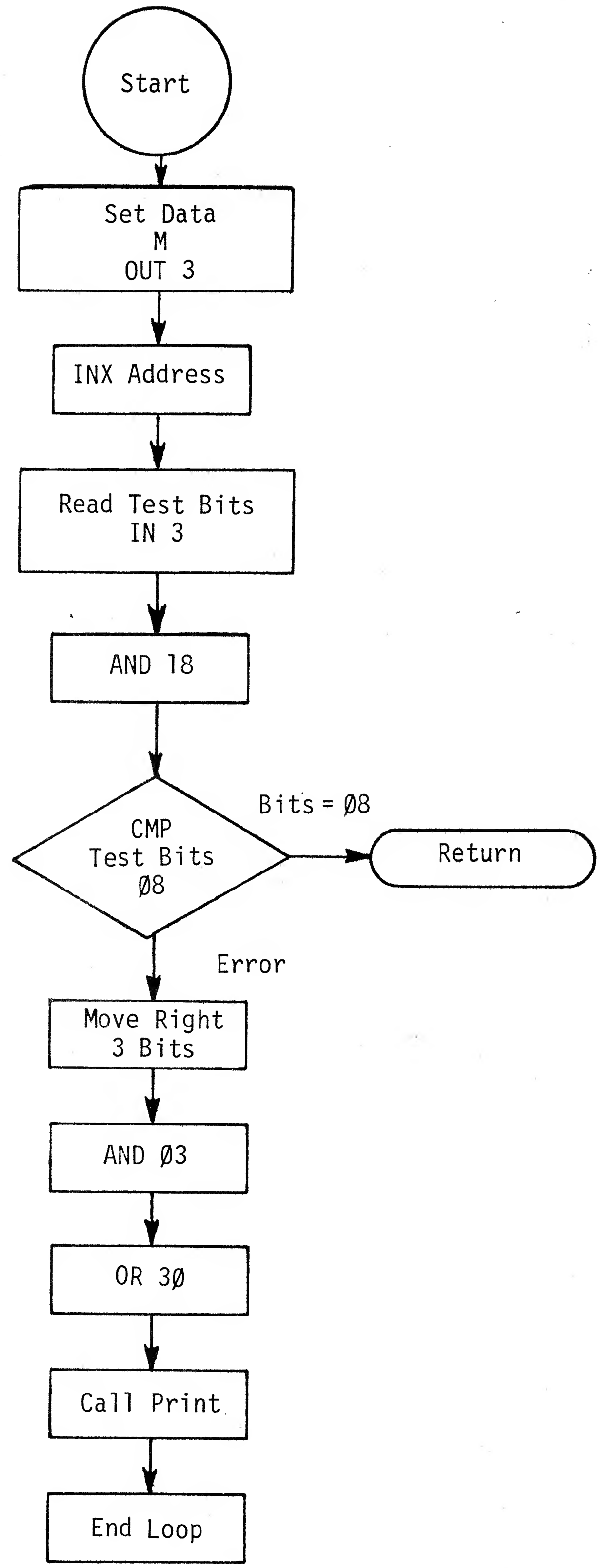



Figure 20. Subroutine Set Data and Test Condition

# WRITE

## 1702A

```
  0000 31  Set Stack    <-- START 1702A
  0001 F4} Pointer
# 0002 01} Ø1F4
  0003 3E} A<-2Ø
  0004 20} LOOP COUNT
  0005 CD  CALL
  0006 C3} INITILIZATION
* 0007 00}
  0008 CD  CALL <-- (B)
  0009 CE} SET
* 000A 00} PARAMETERS
  000B F1  SAVE A(NOP)
  000C C5  PUSH BC
  000D CD  CALL <-- (A)
  000E 2C} SET DATA
* 000F 01} AND TEST
  0010 7B  A<-E  } COMP
  0011 2F  Ā<-A  } Address
  0012 D3} OUT   }
Δ 0013 F1} F1    }
  0014 CD  CALL
  0015 DC} DELAY
* 0016 00} 7 MS
  0017 3E} Set     } SET
  0018 04} A<-Ø4   } PULSE
  0019 D3} OUT     } ON
Δ 001A F0} FØ      }
  001B CD  CALL
  001C F9} DELAY
* 001D 00} 50 US
  001E 3E} Set     } SET
  001F 06} A<-Ø6   } VDD/VGG
  0020 D3} OUT     } ON
Δ 0021 F0} FØ      }
  0022 CD  CALL
  0023 F9} DELAY
* 0024 00} 50 US
  0025 7B  A<-E  } TRUE
  0026 D3} OUT   } Address
Δ 0027 F1} F1    }
  0028 1C  INR E
  0029 CD  CALL
  002A F3} DELAY
* 002B 00} 150 US
  002C 3E} Set     } SET
  002D 07} A<-Ø7   } PROG
  002E D3} OUT     } PULSE
Δ 002F F0} FØ      } ON
  0030 CD  CALL
  0031 E7} DELAY
* 0032 00} 1 MS
  0033 3E} Set     } SET
  0034 06} A<-Ø6   } PROG
  0035 D3} OUT     } PULSE
Δ 0036 F0} FØ      } OFF
  0037 CD  CALL
  0038 F9} DELAY
* 0039 00} 50 US
  003A C1  POP BC
  003B 0B  DCX BC
  003C C5  PUSH BC
  003D CD  CALL
  003E 08} TEST END
* 003F 01}
  0040 DA  JUMP
  0041 0D} ON CARRY --> (A)
* 0042 00}
  0043 C3  JUMP
  0044 08}
* 0045 00}          --> (B)
```

## 2704/2708

```
  0046 31  SET STACK    <-- START 2704/2708
  0047 F4} POINTER
# 0048 01} Ø1F4
  0049 3E} A<-6Ø
  004A 60} LOOP COUNT
  004B CD  CALL
  004C C3} INITILIZATION
* 004D 00}
  004E CD  CALL <-- (B)
  004F CE} SET
* 0050 00} PARAMETER
  0051 F1  SAVE A(NOP)
  0052 C5  PUSH BC
  0053 CD  CALL <-- (A)
  0054 00} ADDRES
* 0055 01}
  0056 CD  CALL
  0057 2C} SET DATA
* 0058 01} AND TEST
  0059 CD  CALL
  005A ED} DELAY
* 005B 00} 0.9 MS
  005C 3E} SET     } SET
  005D 04} A<-Ø4   } PROG
  005E D3} OUT     } PULSE
Δ 005F F0} FØ      } ON
  0060 CD  CALL
  0061 ED} DELAY
* 0062 00} 0.9 MS
  0063 C1  POP BC
  0064 0B  DCX BC
  0065 C5  PUSH BC
  0066 CD  CALL
  0067 08} TEST END
* 0068 01}
  0069 DA  JUMP
  006A 53} ON CARRY --> (A)
* 006B 00}
  006C C3  JUMP
  006D 4E}          --> (B)
* 006E 00}
```

| | |
|---|---|
| WRITE | |
| 1702A............ | 0000 |
| 2708............. | 0046 |
| READ | |
| ALL.............. | 01A0 |
| TEST WRITTEN | |
| ALL.............. | 0070 |
| TEST CLEAR | |
| 1702A............ | 0084 |
| 2708............. | 00AA |
| SET | |
| LENGTH........... | 01F8 |
| | 01F9 |
| PROM START....... | 01FA |
| | 01FB |
| MEMORY START..... | 01FC |
| | 01FD |

## RELOCATION CHANGES

# STACK POINTER AND SET INFOMATION MUST RESIDE IN RAM

Δ THE PROM SETTER I/O ADDRESS

* ADDRESS CHANGE WHEN PROGRAM IS RELOCATED

## TEST WRITTEN

```
 0006F 00  NOP
 0070 31  Set Stack  <--- START
 0071 F5  Pointer
*0072 01  Ø1F5
 0073 CD  CALL
 0074 42  READ 1
*0075 01
 0076 C5  PUSH BC
 0077 1B  DCX DE
 0078 BE  CMP M
 0079 C4  CALL
 007A 61  NOT ZERO
*007B 01  HEX PRINT
 007C 13  INX DE
 007D C1  POP BC
 007E CD  CALL
 007F 4F  READ 2
*0080 01
 0081 C3  JUMP
 0082 76
*0083 00
```

## SUB CLEAR 1

```
 009C 00  NOP
 009D 22  STORE  <--- START
 009E F8  HL
*009F 01
 00A0 21  LXI HL
 00A1 00  START
 00A2 00
 00A3 22  STORE
 00A4 FA  HL
*00A5 01
 00A6 CD  CALL
 00A7 42  READ 1
*00A8 01
 00A9 C9  RETURN
```

## TEST CLEAR

### 1702A

```
 0084 31  SET STACK  <--- START
 0085 F5  POINTER
#0086 01  Ø1F5
 0087 21  LXI HL
 0088 FF  ØØFF
 0089 00
 008A CD  CALL
 008B 9D  CLEAR 1
*008C 00
 008D C5  PUSH BC
 008E 1B  DCX DE
 008F FE  CMP
 0090 00  ØØ
 0091 C4  CALL
 0092 61  NOT ZERO
*0093 01  HEX PRINT
 0094 13  INX DE
 0095 C1  POP BC
 0096 CD  CALL
 0097 4F  READ 2
*0098 01
 0099 C3  JUMP
 009A 8D
*009B 00
```

### 2704/2708

```
 00AA 31  SET STACK  <--- START
 00AB F5  POINTER
#00AC 01  Ø1F5
 00AD 21  LXI HL
 00AE FF  Ø3FF
 00AF 03
 00B0 CD  CALL
 00B1 9D  CLEAR 1
*00B2 00
 00B3 C5  PUSH BC
 00B4 1B  DCX DE
 00B5 FE  CMP
 00B6 FF  FF
 00B7 C4  CALL
 00B8 61  NOT ZERO
*00B9 01  HEX PRINT
 00BA 13  INX DE
 00BB C1  POP BC
 00BC CD  CALL
 00BD 4F  READ 2
*00BE 01
 00BF C3  JUMP
 00C0 B3
*00C1 00
```

## INITIALIZATION

```
    00C2 00   NOP
    00C3 32   STA  <- START
    00C4 F7 } Ø1F7
  * 00C5 01 }
    00C6 3E } SET     } RESET
    00C7 08 } A<-Ø8   }
    00C8 D3 } OUT     } LATCH
  Δ 00C9 F0 } FØ      }
    00CA AF   A<-Ø    } SET
    00CB D3 } OUT     } FOR
  Δ 00CC F0 } FØ      } WRITE
    00CD C9   RETURN
```

## SET PARAMETER

```
    00CE 2A   LOAD HL <- START
    00CF F8 } LENGTH
  * 00D0 01 }
    00D1 23   INX HL
    00D2 E5   PUSH HL
    00D3 C1   POP BC
    00D4 2A   LOAD HL
    00D5 FA }  EPROM
  * 00D6 01 }  START ADDRESS
    00D7 EB   XCHG
    00D8 2A   LOAD HL
    00D9 FC }  MEMORY
    00DA 01 }  START ADDRESS
  * 00DB C9   RETURN
```

SEE PAGE 2 OF ERATTA FOR TIMES WITH WAIT STATES

## DELAY

```
    00DC 01   LXI BC <- START
    00DD 03 } DELAY        7MS
    00DE E0 } Ø3EØ
    00DF 05   DCR B
    00E0 C2   JNZ
    00E1 DF }
  * 00E2 00 }
    00E3 0D   DCR C
    00E4 C2   JNZ
    00E5 DF }
  * 00E6 00 }
    00E7 06 } SET          1MS
    00E8 10 } B<-1Ø
    00E9 05   DCR B
    00EA C2   JNZ
    00EB E9 }
  * 00EC 00 }
    00ED 06 } SET          0.9MS
    00EE 70 } B<-7Ø
    00EF 05   DCR B
    00F0 C2   JNZ
    00F1 EF }
  * 00F2 00 }
    00F3 06 } SET          150µS
    00F4 0E } B<-ØE
    00F5 05   DCR B
    00F6 C2   JNZ
    00F7 F5 }
  * 00F8 00 }
    00F9 06 } SET          50uS
    00FA 03 } B<-Ø3
    00FB 05   DCR B
    00FC C2   JNZ
    00FD FB }
  * 00FE 00 }
    00FF C9   RETURN
```

## SET ADDRESS

```
    0100 7B   A <- E <- START
    0101 D3 } OUT } Lower
  Δ 0102 F1 } F1  } Address
    0103 7A   A <- D
    0104 D3 } OUT } Upper
  Δ 0105 F2 } F2  } Addres
    0106 13   INX DE
    0107 C9   RETURN
```

## TEST END

```
    0108 AF   A <- Ø   } SET     <- START
    0109 D3 } OUT      } CHARGE
  Δ 010A F0 } FØ       }
    010B B9   CMP C  <- START 2
    010C C2   JNZ
    010D 28 }
  * 010E 01 }
    010F B8   CMP B
    0110 C2   JNZ
    0111 28 }
  * 0112 01 }
    0113 3A   LDA     } DECREASE
    0114 F7 }         } LOOP
  * 0115 01 }         } COUNT
    0116 3D   DCR A   }
    0117 32   STA     }
    0118 F7 }         }
  * 0119 01 }         }
    011A FE } CMP
    011B 00 } Ø
    011C C2   JNZ
    011D 2A }
  * 011E 01 }
    011F 21   LXI HL
    0120 C0 } WORD
  * 0121 01 } LOCATION
    0122 CD   CALL
    0123 B0 }  PRINT
  * 0124 01 }  WORD
    0125 C3   JUMP
    0126 25 } LOOP
  * 0127 01 }
    0128 37   Set CARRY=1
    0129 C9   RETURN
    012A B7   Set CARRY=Ø
    012B C9   RETURN
```

## SET DATA AND TEST

```
  012C 7E   A←M    } SET
  012D D3 } OUT    } DATA
△ 012E F3 } F3
  012F 23   INX HL
  0130 DB } READ
△ 0131 F1 } F1
  0132 E6 } AND
  0133 18 } 18
  0134 FE } CMP
  0135 08 } Ø8
  0136 C8   RETURN IF ZERO
  0137 0F } ROTATE   } ERROR
  0138 0F } RIGHT    } WRITE DISABLE ON = 3
  0139 0F }          } OVERCURRENT = Ø
  013A F6 } OR       } BOTH = 2
  013B 30 } 3Ø
  013C CD   CALL
  013D 8F } PRINT
* 013E 01 }
  013F C3   JUMP
  0140 3F 00 } TO EXEC
  0141 01 40 }
```

## READ

```
  0142 3E } Set    } SET      ← START
  0143 08 } A←08   } READ
  0144 D3 } OUT
△ 0145 F0 } FØ
  0146 CD   CALL
  0147 CE } set
* 0148 00 } PARAMETER
  0149 CD   CALL
  014A 00 } set
* 014B 01 } ADDRESS
  014C DB } READ
△ 014D F3 } DATA
  014E C9   RETURN
  014F 23   INX HL    ← START 2
  0150 0B   DCX BC
  0151 AF   A←Ø
  0152 CD   CALL
  0153 0B } TEST
* 0154 01 } 2
  0155 DA   JUMP
  0156 49 } CARRY = 1
* 0157 01 }
  0158 21   LXI HL
  0159 D0 } WORD
* 015A 01 } LOCATION
  015B CD   CALL
  015C B0 } PRINT
* 015D 01 } WORD
  015E C3   JUMP
  015F 5E 00 } LOOP
* 0160 01 40 } EXEC
```

## HEX PRINT

```
  0161 7A   A←D    ← START
  0162 CD   CALL
  0163 75 } HEX 1
* 0164 01 }
  0165 7B   A←E
  0166 CD   CALL
  0167 75 } HEX 1
* 0168 01 }
  0169 06 } Set
  016A 0D } B = CR
  016B CD   CALL
  016C 95 } PRINT
* 016D 01 }
  016E 06 } Set
  016F 0A } B = LF
  0170 CD   CALL
  0171 95 } PRINT
* 0172 01 }
  0173 C9   RETURN
  0174 00   NOP
```

## HEX 1

```
  0175 F5   SAVE A    ← START
  0176 E6 } AND
  0177 F0 } FØ
  0178 0F } ROTATE
  0179 0F } RIGHT
  017A 0F }
  017B 0F }
  017C CD   CALL
  017D 86 } HEX 2
* 017E 01 }
  017F F1   RECOVER A
  0180 E6   AND
  0181 0F   ØF
  0182 CD   CALL
  0183 86 } HEX 2
* 0184 01 }
  0185 C9   RETURN
```

## HEX 2

```
  0186 C6 } ADD     ← START
  0187 30 } 3Ø
  0188 FE } CMP
  0189 3A } 3A
  018A DA   JUMP
  018B 8F } CARRY = 1
* 018C 01 }
  018D C6 } ADD
  018E 07 } Ø7
  018F 47   B←A
  0190 CD   CALL
  0191 95 } PRINT
* 0192 01 }
  0193 C9   RETURN
  0194 00   NOP
```

# TTY WRITE

CD 4BCO

```
  0195 DB } READ  <-- START
▽ 0196 00 } TEST TTY
  0197 E6 } AND
  0198 80 } 8Ø
  0199 C2   JUMP
  019A 95 }
* 019B 01 }
  019C 78   A <- B
  019D D3 } WRITE
▽ 019E 01 } TTY
  019F C9   RETURN
```

▽ TTY I/O ADDRESS

NOTE:
WHEN RELOCATING USING PROGRAM THESE MUST BE CORRECTED.
Ø596 & Ø59E

# READ

```
  01A0 31   Set Stack  <-- START
  01A1 F5 } Pointer
# 01A2 01 } ØIF5
  01A3 CD   CALL
  01A4 42 } READ
* 01A5 01 }
  01A6 77   M <- A
  01A7 CD   CALL
  01A8 4F } READ 2
  01A9 01 }
  01AA C3   JUMP
  01AB A6 }
* 01AC 01 }
  01AD 00   NOP
  01AE 00   NOP
  01AF 00   NOP
```

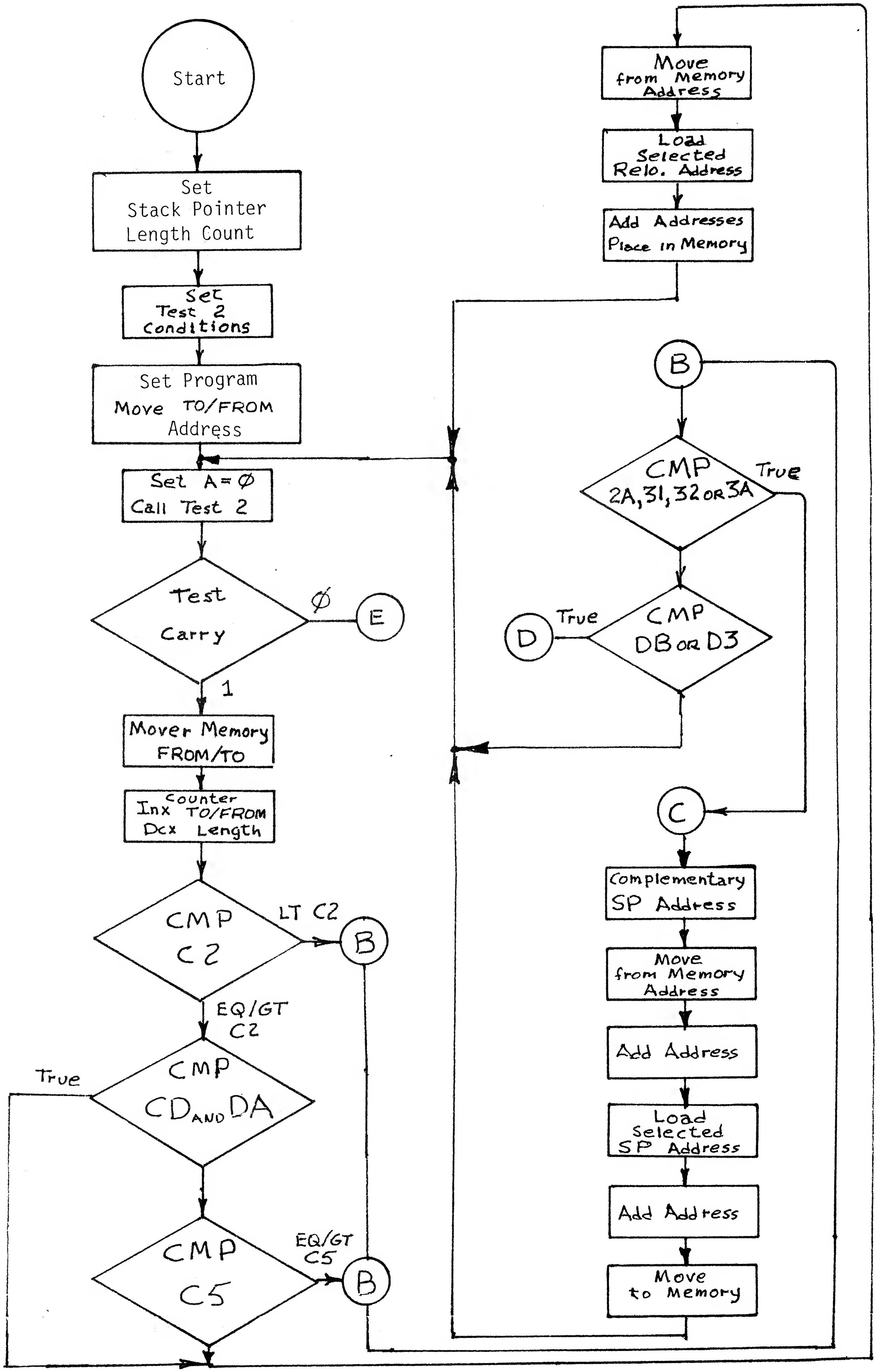
# PRINT WORD

```
  01B0 46   B <- M  <-- START
  01B1 CD   CALL
  01B2 95 } PRINT
* 01B3 01 }
  01B4 23   INX HL
  01B5 FE } CMP
  01B6 80 } 8Ø
  01B7 DA   JUMP
  01B8 B0 } CARRY=1
* 01B9 01 }
  01BA C9   RETURN
```

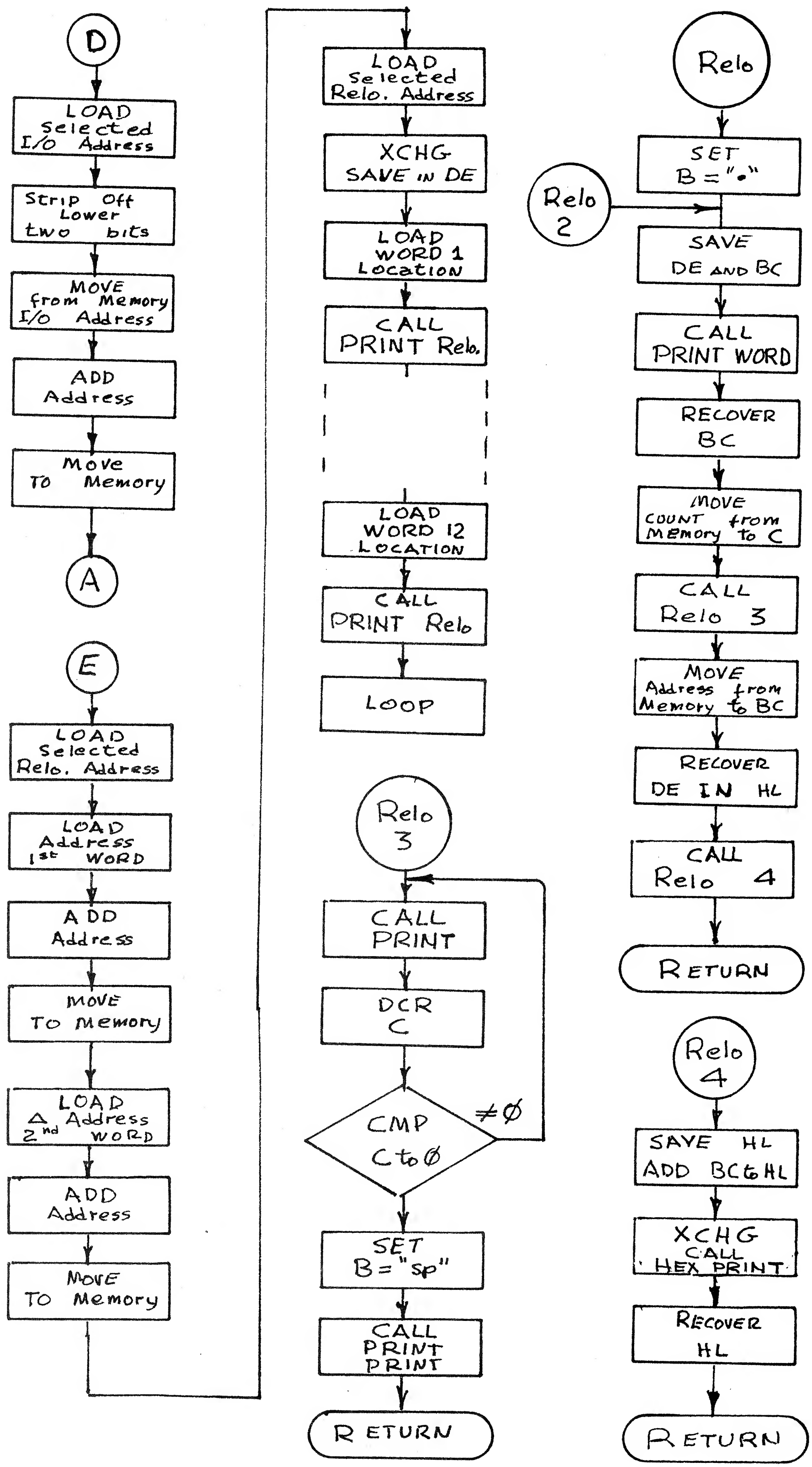
1ST WORD ØICØ to ØICF
2nd WORD ØIDØ to ØIDC

# RELOCATION





Start
Set
Stack Pointer
Length Count
Set
Test 2
Conditions
Set Program
Move TO/FROM
Address
Set A=Ø
Call Test 2
Test
Carry
Ø
E
1
Mover Memory
FROM/TO
Inx Counter TO/FROM
Dcx Length
CMP
C2
LT C2
B
EQ/GT
C2
CMP
CD AND DA
True
CMP
C5
EQ/GT
C5
B
Move
from Memory
Address
Load
Selected
Relo. Address
Add Addresses
Place in Memory
B
CMP
2A, 31, 32 OR 3A
True
CMP
DB OR D3
True
D
C
Complementary
SP Address
Move
from Memory
Address
Add Address
Load
Selected
SP Address
Add Address
Move
to Memory


D
LOAD Selected I/O Address
Strip Off Lower two bits
MOVE from Memory I/O Address
ADD Address
Move To Memory
A
E
LOAD Selected Relo. Address
LOAD Address 1st WORD
ADD Address
MOVE To Memory
LOAD Address 2nd WORD
ADD Address
MOVE To Memory
LOAD Selected Relo. Address
XCHG SAVE IN DE
LOAD WORD 1 Location
CALL PRINT Relo.
LOAD WORD 12 LOCATION
CALL PRINT Relo
Loop
Relo 3
CALL PRINT
DCR C
CMP C to Ø
≠Ø
SET B="sp"
CALL PRINT PRINT
RETURN
Relo
SET B="."
Relo 2
SAVE DE AND BC
CALL PRINT WORD
RECOVER BC
MOVE COUNT from Memory to C
CALL Relo 3
MOVE Address from Memory to BC
RECOVER DE IN HL
CALL Relo 4
RETURN
Relo 4
SAVE HL ADD BC & HL
XCHG CALL HEX PRINT
RECOVER HL
RETURN

# RELOCATION PROGRAM

```
0200 31   Set Stack
0201 F8 } POINTER
0202 03 } Ø3F8
0203 01   LXI BC
0204 E0 } LENGTH
0205 01 } Ø1EØ
0206 3E } Set     } SET
0207 08 } A←Ø8    } FOR
0208 32   STA     } TEST 2
0209 F7 }
020A 01 }
020B 11   LXI DE
020C 00 } MOVE TO (START)
020D 04 } ADDRESS
020E 21   LXI HL
020F 00 } MOVE FROM (START)
0210 00 } ADDRESS
0211 00   NOP
0212 AF   Set A←Ø  ← A
0213 CD   CALL
0214 0B } TEST 2
0215 01 }
0216 D2   JUMP
0217 9C } CARRY=Ø → E
0218 02 }
0219 7E   A←M
021A 12   MDE←A
021B 13   INX DE
021C 23   INX HL
021D 0B   DCX BC
021E FE } CMP
021F C2 } C2
0220 DA   JUMP
0221 49 } CARRY=1 → B
0222 02 }
0223 FE } CMP
0224 CD } CD
0225 CA   JUMP ZERO
0226 32 }
0227 02 } →
0228 FE } CMP
0229 DA } DA
022A CA   JUMP ZERO
022B 32 }
022C 02 } →
022D FE } CMP
022E C5 } C5
022F D2   JUMP
0230 49 } CARRY=Ø → B
0231 02 }
0232 C5   PUSH BC ←
0233 4E   C←M
0234 23   INX HL
0235 46   B←M
0236 23   INX HL
0237 E5   PUSH HL
0238 2A   LOAD HL
0239 FA } RELOCATION
023A 03 } START ADDRESS
```

```
023B 09   DAD BC   Add BC to HL
023C 7D   A←L
023D 12   MDE←A
023E 13   INX DE
023F 7C   A←H
0240 12   MDE←A
0241 13   INX DE
0242 E1   POP HL
0243 C1   POP BC
0244 0B   DCX BC
0245 0B   DCX BC
0246 C3   JUMP
0247 12 } → A
0248 02 }
0249 FE } CMP ← B
024A 2A } 2A
024B CA   JUMP ZERO
024C 6A }
024D 02 } →
024E FE } CMP
024F 31 } 31
0250 CA   JUMP ZERO
0251 6A }
0252 02 } →
0253 FE } CMP
0254 32 } 32
0255 CA   JUMP ZERO
0256 6A }
0257 02 } →
0258 FE } CMP
0259 3A } 3A
025A CA   JUMP ZERO
025B 6A }
025C 02 } → C
025D FE } CMP
025E DB } DB
025F CA   JUMP ZERO
0260 89 }
0261 02 } →
0262 FE } CMP
0263 D3 } D3
0264 CA   JUMP ZERO
0265 89 }
0266 02 } → D
0267 C3   JUMP
0268 12 } → A
0269 02 }
026A C5   PUSH BC ← C
026B 01   LXI BC
026C 0C } COMPLEMENTARY
026D FE } STACK POINTER
026E D5   PUSH DE
026F 5E   E←M
0270 23   INX HL
0271 56   D←M
0272 23   INX HL
0273 EB   XCHG
0274 09   DAD BC
0275 4D   C←L
0276 44   B←H
```

```
0277 2A   LOAD HL
0278 FC } RAM
0279 03 } STACK POINTER
          ADDRESS
027A 09   DAD BC
027B 4D   C ← L
027C 44   B ← H
027D E1   POP HL
027E 71   M ← C
027F 23   INX HL
0280 70   M ← B
0281 23   INX HL
0282 C1   POP BC
0283 0B   DCX BC
0284 0B   DCX BC
0285 EB   XCHG
0286 C3   JUMP
0287 12 }
0288 02 } → A
0289 3A   LDA ← D
028A FE } NEW
028B 03 } I/O ADDRESS
028C E6 } AND
028D FC } FC
028E C5   PUSH BC
028F 47   B ← A
0290 7E   A ← M
0291 23   INX HL
0292 E6 } AND
0293 03 } Ø3
0294 80   ADD B to A
0295 C1   POP BC
0296 12   M DE ← A
0297 13   INX DE
0298 0B   DCX BC
0299 C3   JUMP
029A 12 }
029B 02 } → A
029C 2A   LOAD HL ← E
029D FA } RELOCATION
029E 03 } START ADDRESS
029F 01   LXI BC
02A0 C0 } 1st WORD
02A1 01 } ADDRESS
02A2 09   DAD BC
02A3 22   STORE HL
02A4 20 } Ø52Ø
02A5 05 }
02A6 01   LXI BC
02A7 10 } 2nd WORD
02A8 00 } (ADD TO 1st)
02A9 09   DAD BC
02AA 22   STORE HL
02AB 59 } Ø559
02AC 05 }
02AD 2A   LOAD HL
02AE FA } RELOCATION
02AF 03 } START ADDRESS
02B0 01
02B1 8F }
02B2 01 }
```

```
02B3 09   DAD BC
02B4 22   STORE HL
02B5 8B } Ø58B
02B6 05 }
02B7 3E } Set
02B8 DA } A = DA
02B9 32   STA
02BA 8A } Ø58A
02BB 05 }
02BC AF   set A = Ø
02BD 32   STA
02BE 96 } Ø596
02BF 05 }
02C0 3C   INR A
02C1 32   STA
02C2 9E } Ø59E
02C3 05 }
02C4 2A   LOAD HL
02C5 FA } RELOCATION
02C6 03 } START ADDRESS
02C7 EB   STORE IN DE
02C8 21   LOAD HL
02C9 20 } WORD
02CA 03 } LOCATION
02CB 06 } LOOP COUNT
02CC 06 } SET B = Ø6
02CD C5   PUSH BC ←
02CE CD   CALL
02CF F0 } PRINT
02D0 02 } Relo
02D1 C1   POP BC
02D2 05   DCR BC
02D3 C2   JNZ
02D4 CD }
02D5 02 }
02D6 2A   LOAD HL
02D7 FC } STACK POINTER
02D8 03 } ADDRESS
02D9 EB   STORE IN DE
02DA 21   LOAD HL
02DB 9A } WORD
02DC 03 } LOCATION
02DD 06 } LOOP COUNT
02DE 03 } set B = Ø3
02DF C5   PUSH BC ←
02E0 CD   CALL
02E1 F0 } PRINT
02E2 02 } Relo
02E3 06 } set
02E4 20 } B = "sp"
02E5 CD   CALL
02E6 F2 } Relo 2
02E7 02 }
02E8 C1   POP BC
02E9 05   DCR BC
02EA C2   JNZ
02EB DF }
02EC 02 }
02ED C3   LOOP ←
02EE ED }
02EF 02 }
```

SUBRUTINE Relo

```
02F0 06 } SET B = "."
02F1 2E }
02F2 C5   PUSH BC ← START 2
02F3 CD   CALL
02F4 B0 } PRINT
02F5 01 } WORD
02F6 C1   POP BC
02F7 4E   C ← M
02F8 23   INX HL
02F9 CD   CALL
02FA 04 } Relo 3
02FB 03 }
02FC 4E   C ← M
02FD 23   INX HL
02FE 46   B ← M
02FF 23   INX HL
0300 CD   CALL
0301 14 } Relo 4
0302 03 }
0303 C9   RETURN
```

Relo 3

```
0304 CD   CALL ←
0305 95 } PRINT
0306 01 }
0307 0D   DCR C
0308 C2   JNZ
0309 04 }
030A 03 }
030B 06 } Set
030C 20 } B = "sp"
030D CD   CALL
030E 95 } PRINT
030F 01 }
0310 CD   CALL
0311 95 } PRINT
0312 01 }
0313 C9   RETURN
```

Relo 4

```
0314 D5   PUSH DE
0315 EB   XCHG DE ⇄ HL
0316 09   DAD BC
0317 EB   XCHG DE ⇄ HL
0318 CD   CALL
0319 61 } HEX PRINT
031A 01 }
031B D1   POP DE
031C C9   RETURN
031D 00   NOP
031E 00   NOP
031F 00   NOP
```

```
0320 0D  CR
0321 0A  LF
0322 00  NOP
0323 00  NOP
0324 52  R
0325 4C  L
0326 2E  .
0327 20  SP
0328 41  A
0329 44  D
032A 44  D
032B 52  R
032C 45  E
032D 53  S
032E 53  S
032F 45  E
0330 53  S
0331 0D  CR
0332 0A  LF
0333 0A  LF
0334 00  SP
0335 57  W
0336 52  R
0337 49  I
0338 54  T
0339 45  E
033A 0D  CR
033B 0A  LF
033C 00  NOP
033D 00  NOP
033E 20  SP
033F 20  SP
0340 31  1
0341 37  7
0342 30  0
0343 32  2
0344 C1  A
0345 0C  COUNT
0346 00} 1702A
0347 00} ADDRESS
0348 20  SP
0349 20  SP
034A 32  2
034B 37  7
034C 30  0
034D B8  8
034E 0D  COUNT
034F 46  2708
0350 00  ADDRESS
0351 52  R
0352 45  E
0353 41  A
0354 44  D
0355 0D  CR
0356 0A  LF
0357 00  NOP
0358 00  NOP
0359 20  SP
035A 20  SP
035B 41  A
035C 4C  L
035D CC  L
035E 0E  COUNT
035F A0  READ
0360 01  ADDRESS
```

```
0361 54  T
0362 45  E
0363 53  S
0364 54  T
0365 20  SP
0366 57  W
0367 52  R
0368 49  I
0369 54  T
036A 54  T
036B 45  E
036C 4E  N
036D 0D  CR
036E 0A  LF
036F 00  NOP
0370 00  NOP
0371 20  SP
0372 20  SP
0373 41  A
0374 4C  L
0375 CC  L
0376 0E  COUNT
0377 70} TEST
0378 00} ADDRESS
0379 54  T
037A 45  E
037B 53  S
037C 54  T
037D 20  SP
037E 43  C
037F 4C  L
0380 45  E
0381 41  A
0382 52  R
0383 0D  CR
0384 0A  LF
0385 00  NOP
0386 00  NOP
0387 20  SP
0388 20  SP
0389 31  1
038A 37  7
038B 30  0
038C 32  2
038D C1  A
038E 0C  COUNT
038F 84} 1702A TEST
0390 00} ADDRESS
0391 20  SP
0392 20  SP
0393 32  2
0394 37  7
0395 30  0
0396 B8  8
0397 0D  COUNT
0398 AA  2708 TEST
0399 00  ADDRESS
```

```
039A 53  S
039B 45  E
039C 54  T
039D 0D  CR
039E 0A  LF
039F 00  NOP
03A0 00  NOP
03A1 20  SP
03A2 20  SP
03A3 4C  L
03A4 45  E
03A5 4E  N
03A6 47  G
03A7 54  T
03A8 C8  H
03A9 0B  COUNT
03AA 04} SET LOWER LENGTH
03AB 00} ADDRESS
03AC A0  SP
03AD 12  COUNT
03AE 05} SET UPPER LENGTH
03AF 00} ADDRESS
03B0 20  SP
03B1 20  SP
03B2 50  P
03B3 52  R
03B4 4F  O
03B5 4D  M
03B6 20  SP
03B7 53  S
03B8 54  T
03B9 41  A
03BA 52  R
03BB D4  T
03BC 07  COUNT
03BD 06} SET LOWER PROM START
03BE 00} ADDRESS
03BF A0  SP
03C0 12  COUNT
03C1 07} SET UPPER PROM START
03C2 00} ADDRESS
03C3 20  SP
03C4 20  SP
03C5 4D  M
03C6 45  E
03C7 4D  M
03C8 4F  O
03C9 52  R
03CA 59  Y
03CB 20  SP
03CC 53  S
03CD 54  T
03CE 41  A
03CF 52  R
03D0 D4  T
03D1 05  COUNT
03D2 08} SET LOWER MEMORY
03D3 00} START ADDRESS
03D4 A0  SP
03D5 12  COUNT
03D6 09} SET UPPER MEMORY
03D7 00} START ADDRESS
```

# COMPONENT LAYOUT
# AND
# SCHEMATIC

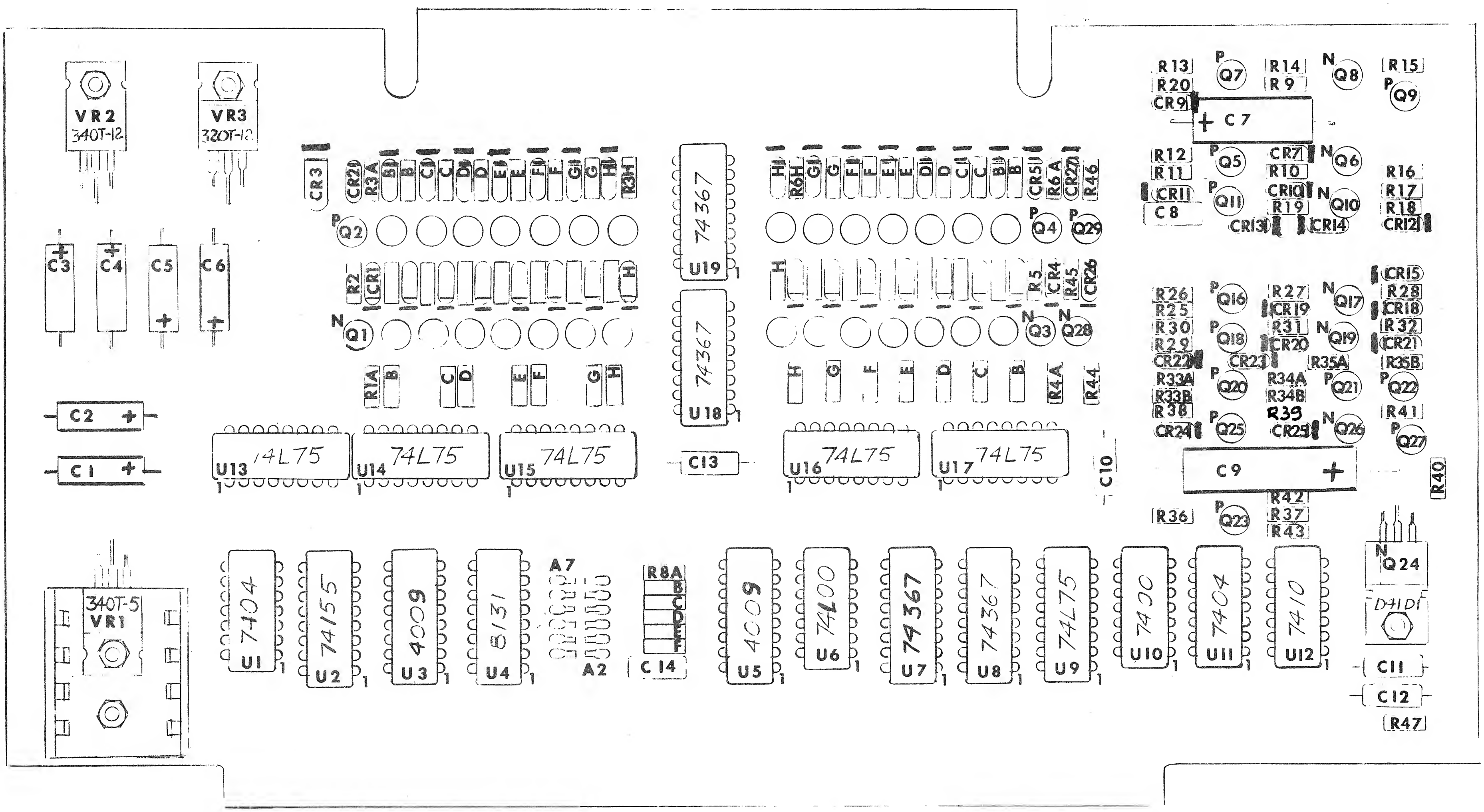
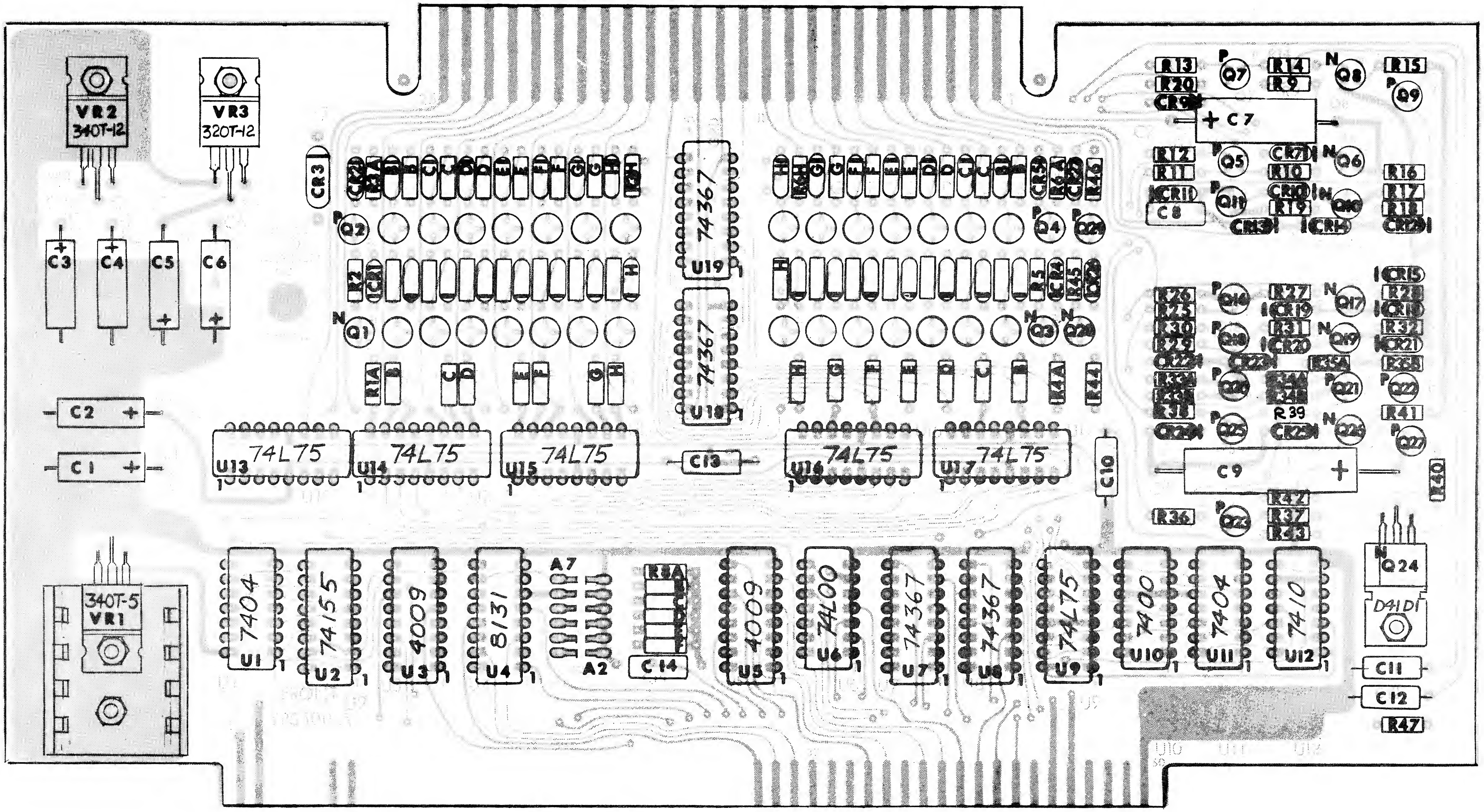



Figure 30. Component Layout



VR2
340T-12
VR3
320T-12
VR1
340T-5
C1
C2
C3
C4
C5
C6
CR3
74367
U19
74367
U18
74L75
U13
74L75
U14
74L75
U15
74L75
U16
74L75
U17
C13
C10
C7
C8
C9
C11
C12
Q24
D41D1
R47
R40
R36
R39
7404
U1
74155
U2
4009
U3
8131
U4
A7
A2
C14
4009
U5
74L00
U6
74367
U7
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U8
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U9
7400
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7404
U11
7410
U12

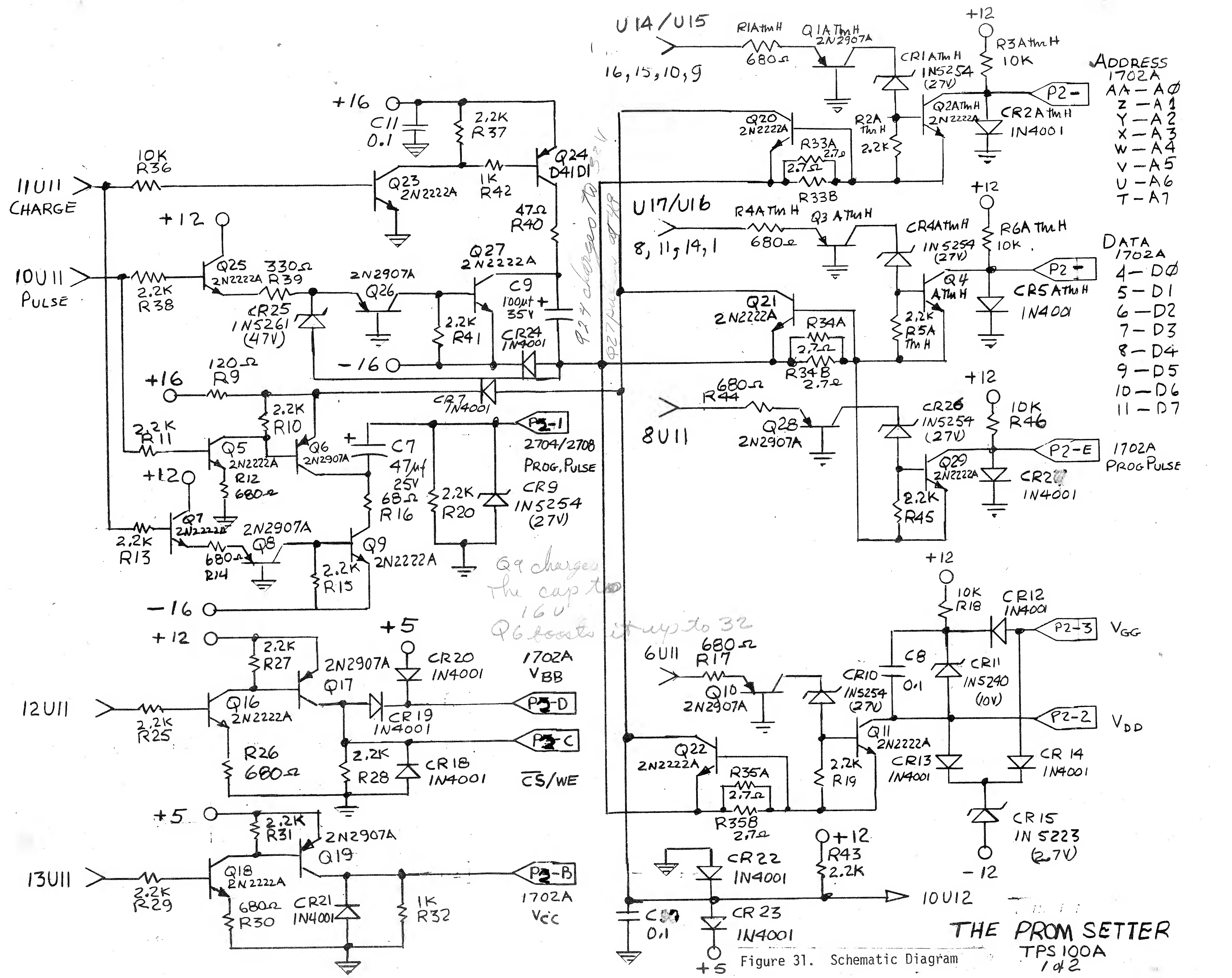



Figure 31. Schematic Diagram

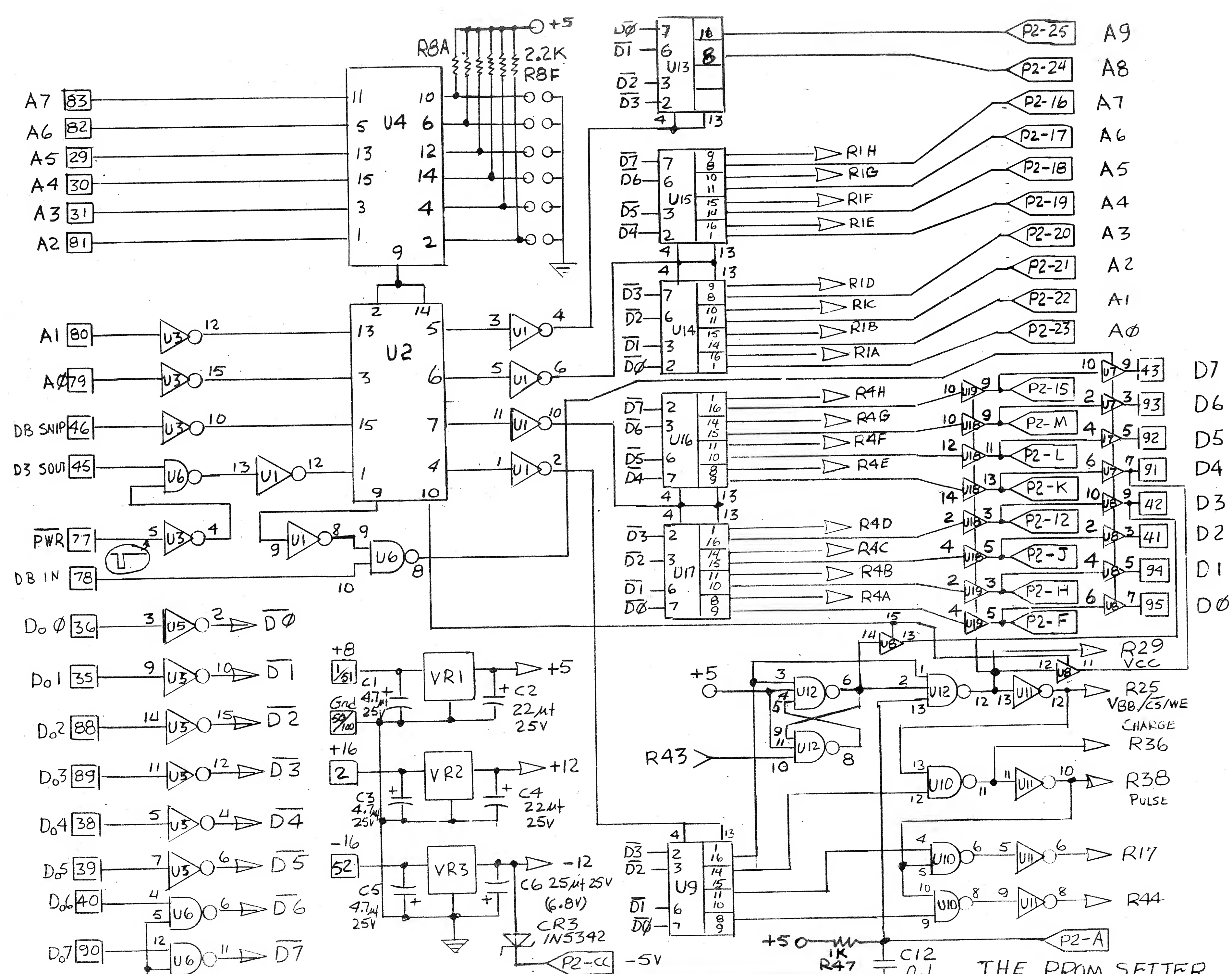



Figure 31. Schematic Diagram

# APPENDIX

## APPENDIX I
## WARRANTY

The parts supplied in the PROM SETTER are warranteed against defects in material and workmanship for a period of 90 days after the date of shipment or purchase, whichever is the later date.

Any malfunctioning module, purchased as a kit within the above warranty period, which in our judgment has been assembled with normal care, and not subject to mechanical or electrical abuse, will be restored to proper operating condition for shipping and handling charge of $2.50.

Any malfuncting module, purchased as a kit not covered by the above conditions will be repaired and returned at a cost commensurate with the work required. In NO CASE will the charge exceed $22.50 without prior notification and approval of the owner.

Any module purchased assembled is guaranteed to meet specifications as in effect at the time of manufacture for the full warranty period. If malfunctioning occurs to these modules within the warranty period they will be repaired without charge providing that no attempt was made to modify the unit.

This warranty is made in lieu of all other warranties expressed or implied, and is limited in any case to the repair or replacement of the module involved.

# APPENDIX II

## Assembly, Soldering and Cleaning Notes

General: Assembly of printed circuit boards can range from very "shoddy" to "beautiful" in the workmanship category. My experience over the years has indicated to me that a printed circuit board "works about like it looks." I find that if great care is used in assembly and soldering, one experiences a certain pride in workmanship and a board usually functions that way in an almost "human" manner, i.e., with pride.

A few do's and don't's may help your workmanship.

DO's

1) Familiarize yourself with the general operations to be performed.

2) Make sure all necessary tools, materials, parts, etc. are available.

3) Make sure tools, fixtures, etc., are clean and in good working order.

4) Arrange tools in order of usage and frequency.

5) Orient tools for easy grasp.

6) Select proper soldering iron, tip, wattage, etc., required for the job.

7) Be sure chair is proper height and comfortable for your work station.

8) Keep work area clean and uncluttered.

9) Obey all safety precautions and exercise good judgment at all times.

10) Strive for neatness and uniformity.

11) Keep food and drink away from work area.

12) Remove bits and pieces of scrap wire, solder pieces, as you progress so they do not become buried in your work.

DON'T'S

1) Don't have unnecessary items at your work station.

2) Don't have worn or damaged tools at your work area.

3) Don't solder on equipment that is plugged in.

4) Don't use unknown cleaning solutions.

5) Never pull on a solder joint to see if it is good.

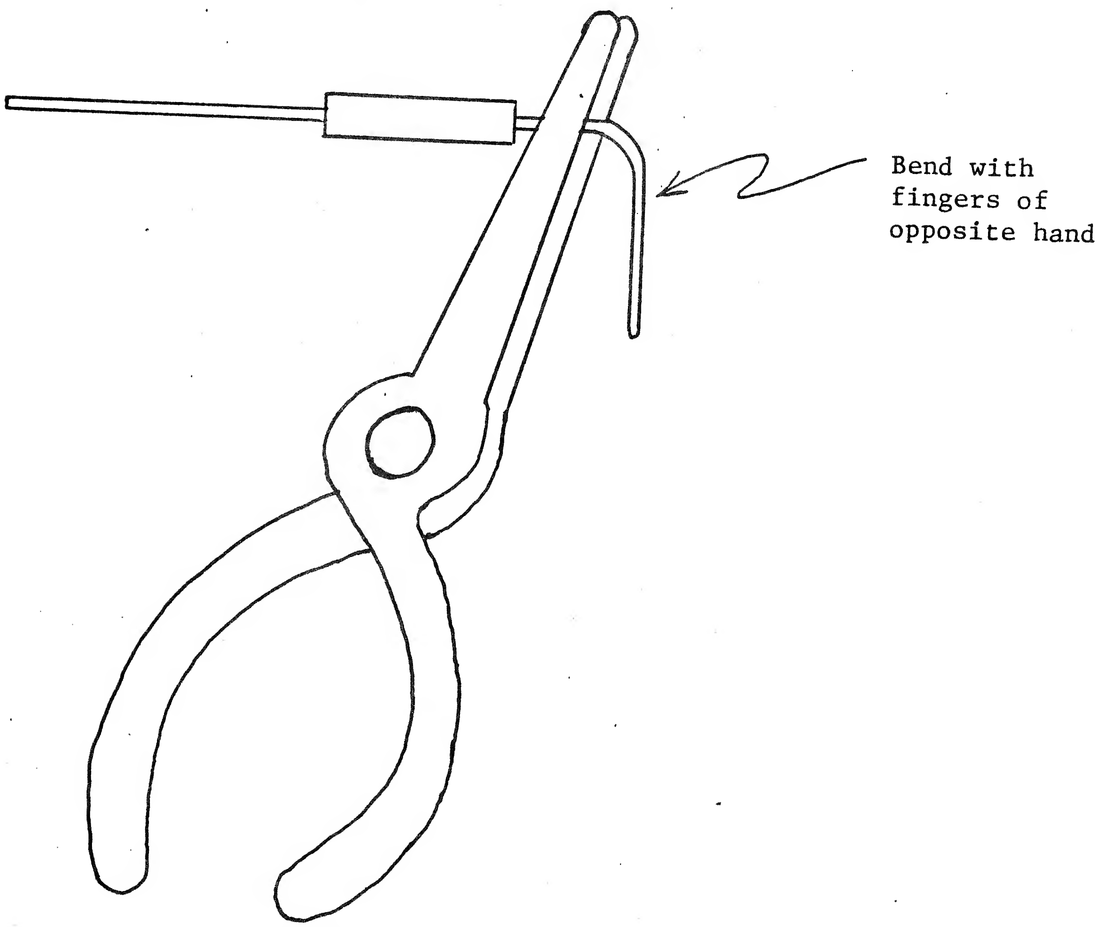
6) Never flip excess solder off of your soldering iron.

7) Never add solder to your iron then transfer it to a cold joint.

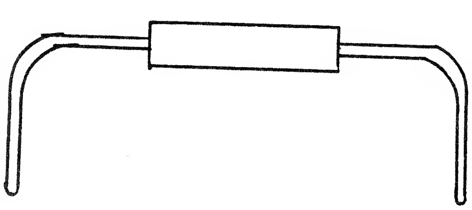
# APPENDIX II

## Assembly

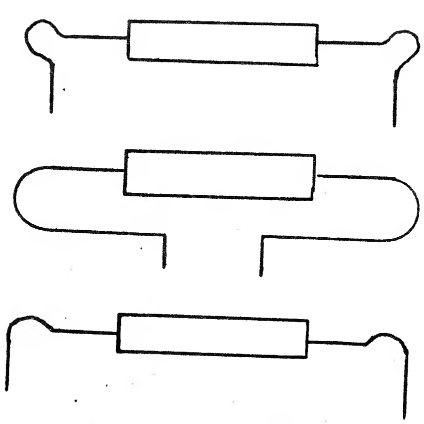
Lead forming - Lead forming is performed by grasping the body of the part with the fingers of one hand. With the other hand holding long-nose pliers, grasp the lead near the body with the taper of the pliers defining the length of lead from body of the part to the lead. Bend the lead with the opposite hand to form the bend as in the following figure.




Hand Forming Operation



Preferred Bend Configuration

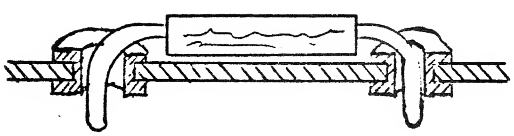


Alternate Bend Configurations

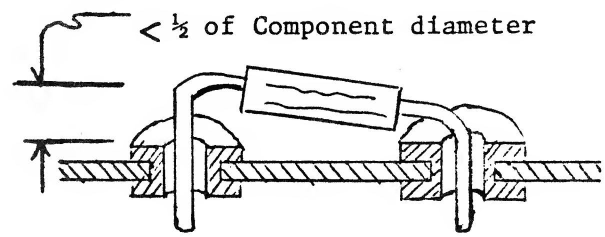
The lead should have a discernible length extending straight from the body of the component before beginning the bend. The component body shall not be damaged nor the body-to-lead seal damaged by the forming operation. The component should be centered between the bends, although this is not a requirement. Where feasible, all forming should be done so that the part number is visible when installed in the circuit board.

## Component Installation

Install all components in their proper location, and if polarity is important, observe the proper markings. The component should be installed flush with the circuit board, unless a clearance is specifically called out. This clearance is suually required for hot components that might burn or discolor the printed circuit board.



GOOD (Before Soldering




ACCEPTABLE

## Soldering

Soldering techniques probably are the hardest to master of any electronic assembly technique. If you have never soldered at all, it is probably best that you practice on some old scrap printed circuit board available at most electronic part stores and surplus shops.

For electronic assembly, always use <u>resin</u> core solder, not <u>acid</u> core solder. Acid core solder will corrode, and it's impossible to stop the corrosion. It will eventually ruin the printed circuit board.

A soldering iron of small wattage, preferably 27 watts to 40 watts maximum, should be used. Always keep the tip clean and free from dross (oxidized solder) by wiping on a moistened sponge or folded-up Kleenex (moistened). Use small solder with a 60 - 40 ratio which means 60% tin and 40% lead.

When ready to solder a joint, apply heat to the joint first, then apply the solder to the opposite side of the joint from the iron (see Figure 1). Then remove the solder and finally the soldering iron. A good solder joint has an even flow of solder over the entire joint. A good joint will have a bright glistening look. A bad solder joint, commonly called a cold solder joint, will have a dull appearance. Also, do not move the part or lead while the solder is cooling or a cold or fractured solder joint will result (see Figure 2).

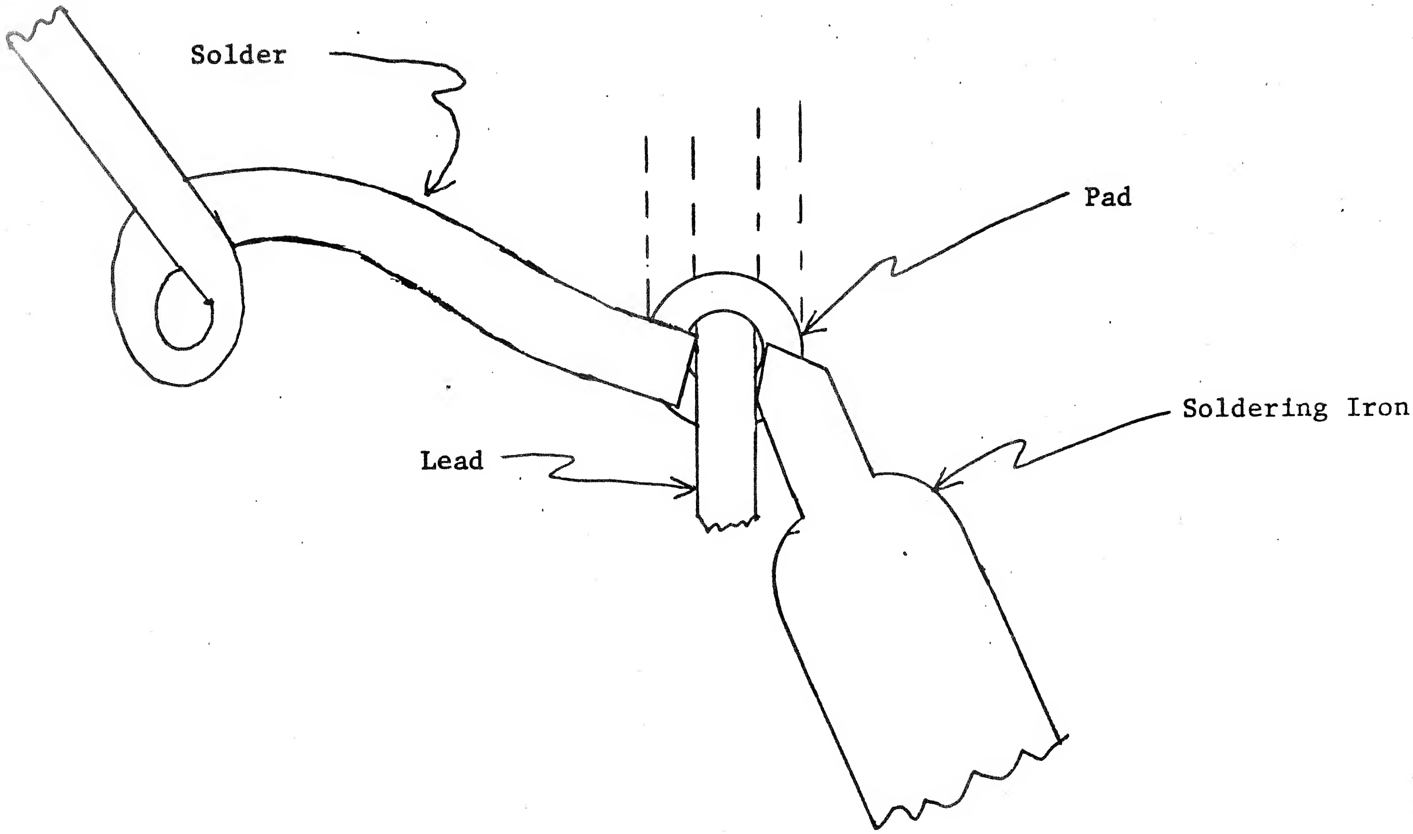
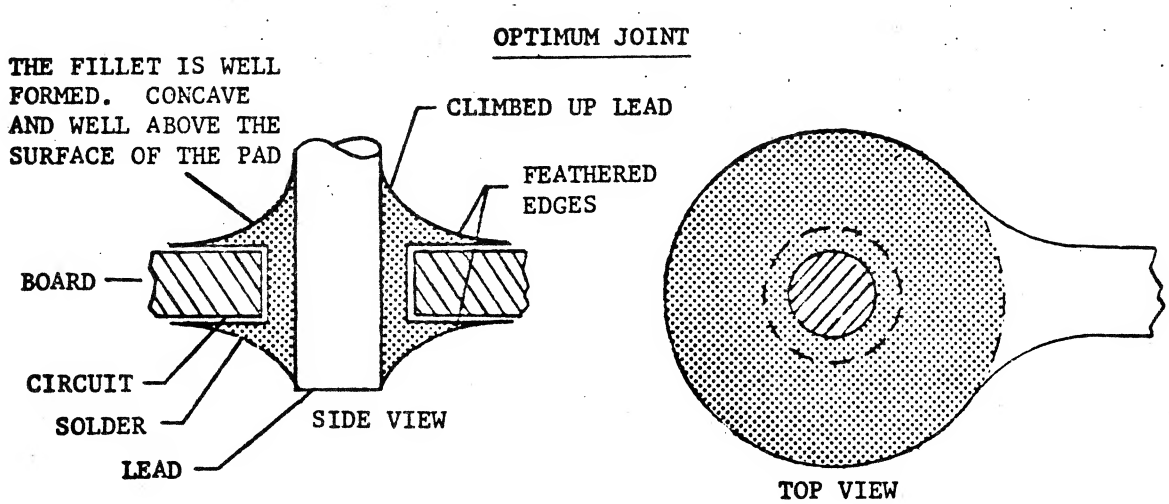


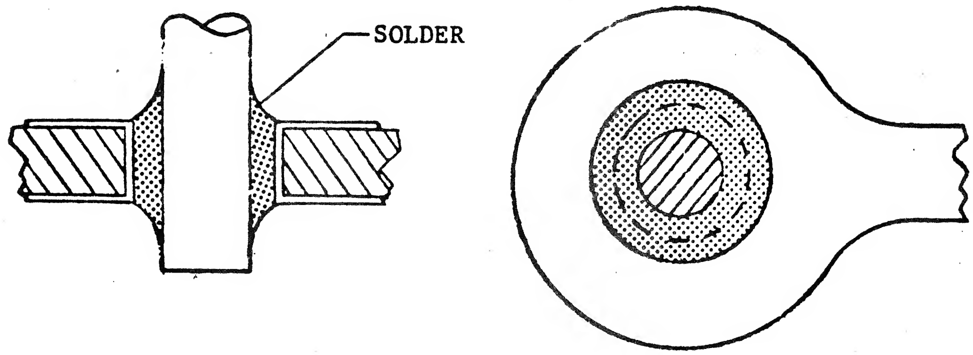

Figure 1 -Solding Technique-apply solder to opposite side of lead from the soldering iron




THE SOLDER SHALL BE CLEAN, SMOOTH AND BRIGHT

Figure 2a

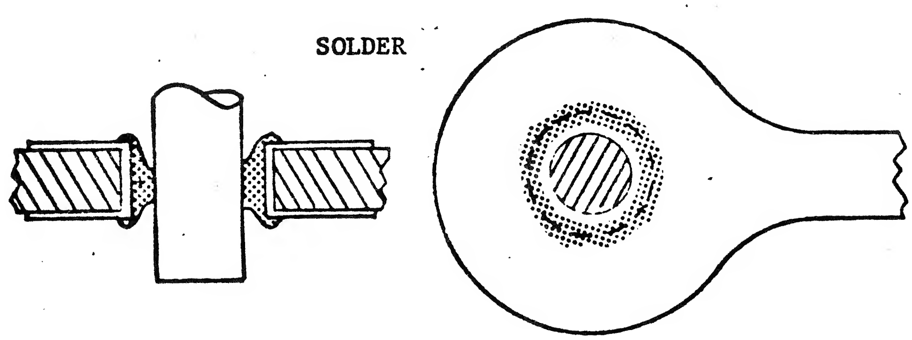
MINIMUM SOLDER ACCEPTABLE




SOLDER FLOW RESULTING IN A MINUTE FILLET RADIUS ON EITHER OR BOTH SIDES OF THE BOARD IS ACCEPTABLE.

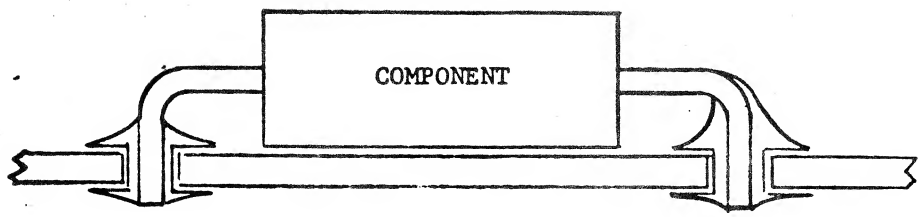
Figure 2b

INSUFFICIENT SOLDER




INSUFFICIENT SOLDER. INDICATED BY LACK OF FILLET ON ONE OR BOTH SIDES OF BOARD.

Figure 2c



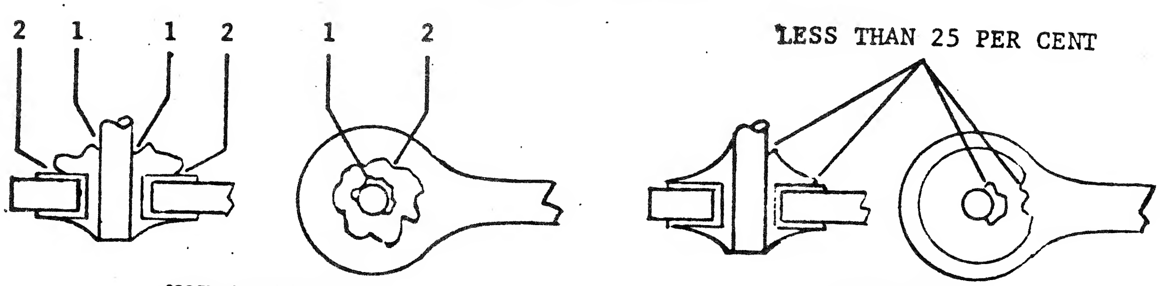

ACCEPTABLE

STRESS RELIEF AND SOLDER BUILD-UP ON AXIAL LEAD COMPONENTS

AT LEAST ONE END OF AXIAL LEAD COMPONENTS SHALL HAVE ADEQUATE STRESS RELIEF AND ABSENCE OF SOLDER BUILD UP.

Figure 2d

LACK OF ADHESION




NOT ACCEPTABLE

LACK OF ADHESION INDICATED BY EVIDENCE 1 THE LEAD IS NOT WET ON COMPONENT SIDE, OR 2 THE PAD IS NOT WET AT THE SOLDER PAD INTERFACE.

ACCEPTABLE

LACK OF ADHESION CONFINED TO LESS THAN 25% OF THE LEAD PERIMETER SHALL BE ACCEPTABLE PROVIDED THE LACK DOES NOT EXTEND BENEATH BOARD SURFACE. IF DEFECT EXTENDS BELOW, THE LIMIT IS 10% OF LEAD PERIMETER.

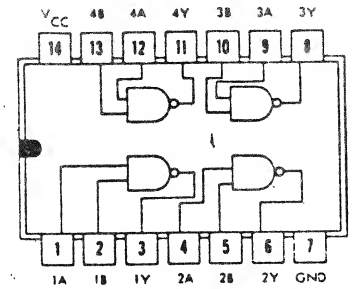
Figure 2e

## APPENDIX II

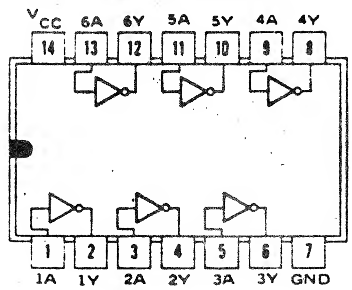
### Cleaning

After you have finished soldering, a flux residue will be left on the board. This is the resin that is in the solder core. With a pan of alcohol and a small brush, i.e., paint brush, old toothbrush, wash both sides of the board with the alcohol and scrub with the brush. An indistrial solution called "Alpha" may also be used. After you have washed the resin off, examine the board on both sides for any residue of etch or "solder bridges," splashes, etc. Do this under a strong light or preferably a X10 microscope. With a fine pointed instrument, such as a jewelers screwdriver or small pointed metal pick, scrape between printed wiring etches which are close together. This may take some time, but it is well worth it, since solder shorts on prinred circuit boards may take several hours to find and identify.

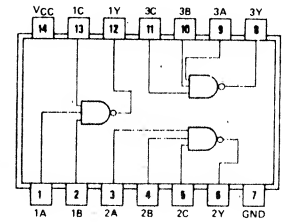
# 7400



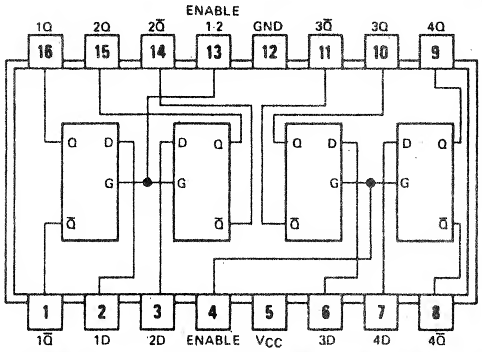

# 7404




# 7410




# 74L75

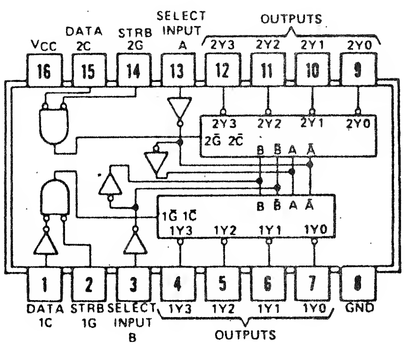



FUNCTION TABLE
(Each Latch)

| INPUTS | | OUTPUTS | |
|---|---|---|---|
| D | G | Q | $\bar{Q}$ |
| L | H | L | H |
| H | H | H | L |
| X | L | $Q_0$ | $\bar{Q}_0$ |

H = high level, L = low level, X = Irrelevant
$Q_0$ = the level of Q before the high-to-low transition of G

# 74155

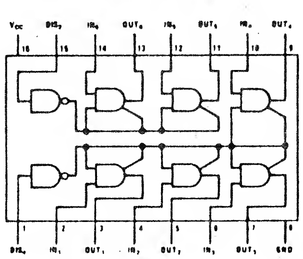



2-LINE-TO-4-LINE DECODER
OR 1-LINE-TO-4-LINE DEMULTIPLEXER

| INPUTS | | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|---|
| SELECT | | STROBE | DATA | | | | |
| B | A | 1G | 1C | 1Y0 | 1Y1 | 1Y2 | 1Y3 |
| X | X | H | X | H | H | H | H |
| L | L | L | H | L | H | H | H |
| L | H | L | H | H | L | H | H |
| H | L | L | H | H | H | L | H |
| H | H | L | H | H | H | H | L |
| X | X | X | L | H | H | H | H |

| INPUTS | | | | OUTPUTS | | | |
|---|---|---|---|---|---|---|---|
| SELECT | | STROBE | DATA | | | | |
| B | A | 2G | 2C | 2Y0 | 2Y1 | 2Y2 | 2Y3 |
| X | X | H | X | H | H | H | H |
| L | L | L | L | L | H | H | H |
| L | H | L | L | H | L | H | H |
| H | L | L | L | H | H | L | H |
| H | H | L | L | H | H | H | L |
| X | X | X | H | H | H | H | H |

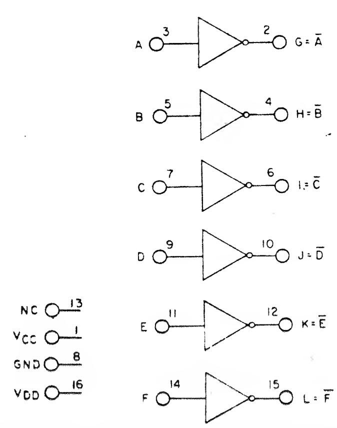
# 74367




| DISABLE $DIS_4$ | INPUT $DIS_2$ | INPUT | OUTPUT |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| X | 1 | X | H-z* |
| 1 | X | X | H-z** |

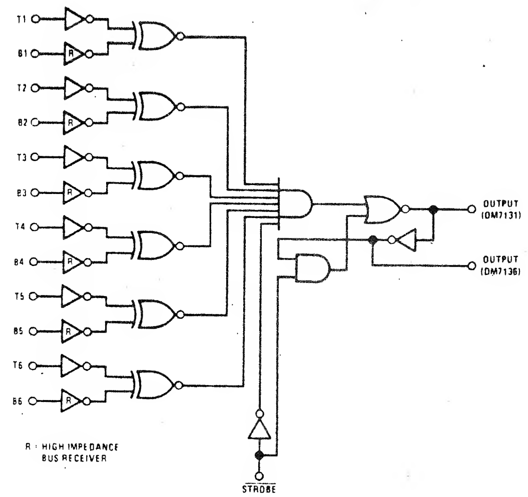
*Output 5-6 only
**Output 1-4 only
X = Irrelevant

# 4009

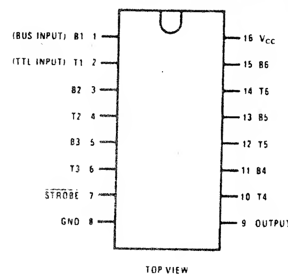


## logic and connection diagrams

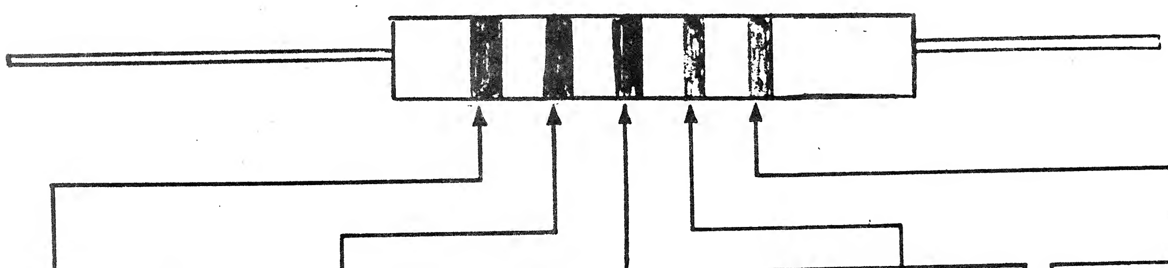
# 8131




Dual-In-Line and Flat Package




STANDARD COLOR CODE



| First Band<br>1st Digit | |
|---|---|
| **Color** | **Digit** |
| Black | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

| Second Band<br>2nd Digit | |
|---|---|
| **Color** | **Digit** |
| Black | 0 |
| Brown | 1 |
| Red | 2 |
| Orange | 3 |
| Yellow | 4 |
| Green | 5 |
| Blue | 6 |
| Violet | 7 |
| Gray | 8 |
| White | 9 |

| Third Band<br>Multiplier | |
|---|---|
| **Color** | **Multiplier** |
| Black | 1 |
| Brown | 10 |
| Red | 100 |
| Orange | 1,000 |
| Yellow | 10,000 |
| Green | 100,000 |
| Blue | 1,000,000 |
| Silver | 0.01 |
| Gold | 0.1 |

| Fourth Band*<br>Resistance Tolerance | |
|---|---|
| **Color** | **Tolerance** |
| Silver | ±10% |
| Gold | ± 5% |
| *No Band | ±20% |

| Fifth Band*<br>Reliability Level<br>(Percent Per 1,000 Hours) | |
|---|---|
| **Color** | **Level** |
| Brown | M = 1.0% |
| Red | P = 0.1% |
| Orange | R = 0.01% |
| Yellow | S = 0.001% |

*MIL-R-39008 Resistors Only

RESISTOR BAND COLOR CODE

# FEEDBACK AND GRIPES

We at Szerlip Enterprises are interested in you, our customer, providing us feedback as to your usage of our product, so that we may better serve you in the future. We appreciate your response and hope you will take a moment to fill out the questionnaire and return it to the address below:

Szerlip Enterprises
1414 West 259th Street
Harbor City, CA 90710

Comment

1) Was your memory board received in a reasonable length of time? YES NO
2) Was anything damaged in shipment? YES NO
3) Were any parts missing? YES NO
   If yes, what? ______________________________
4) Was the quality of the material and workmanship reasonable? YES NO
5) Did you have any trouble understanding the manual? YES NO
   If yes, what area? ______________________________
6) Have you encountered any problems with the memory board? YES NO
   If yes, what? ______________________________

   ______________________________

   ______________________________
7) Did you solve the problem? YES NO
   If yes, how? ______________________________

   ______________________________

   ______________________________
8) Are you dissatisfied with the memory board? YES NO
   If yes, in what way? ______________________________

   ______________________________

   ______________________________
9) Do you have any suggestions for design improvements? YES NO
   If yes, what? ______________________________

   ______________________________

   ______________________________

10) What is the major disadvantage of this memory board?

______________________________________________

______________________________________________

______________________________________________

11) What is your name, address and phone number?

NAME ______________________________________

ADDRESS ___________________________________

___________________________________________

PHONE # ( ) ________________________________

12) Other comments?

______________________________________________

______________________________________________

______________________________________________

______________________________________________

13) Other criticism?

Write here → ☐